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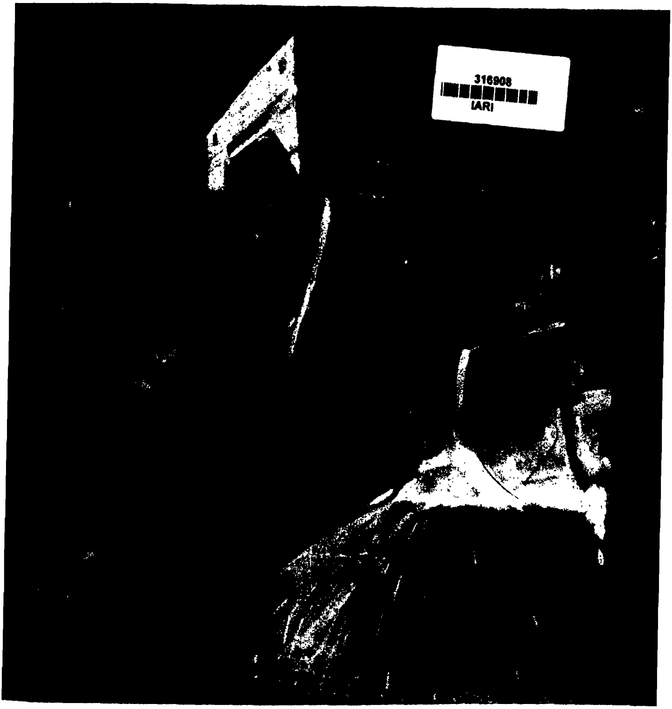

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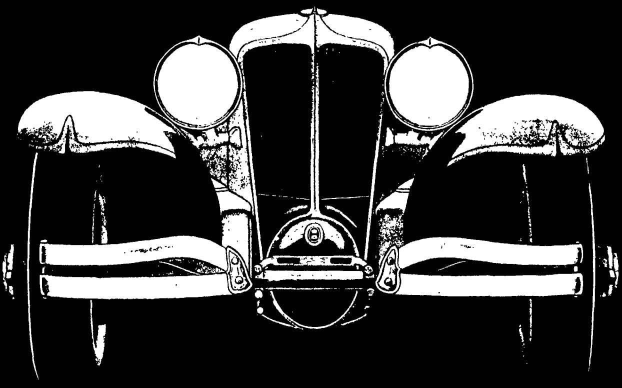

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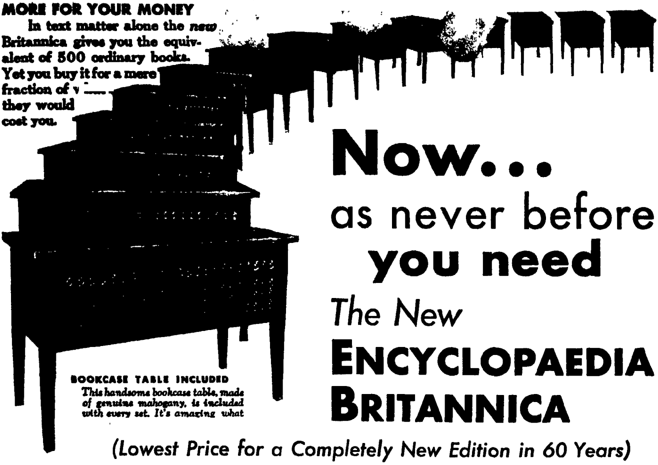

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EIGHTY-SEVENTH YEAR • **ORSON D. MUNN, Editor**

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THIS MONTH'S COVER

Relating to the article on page 26, our cover painting this month, by our artist Howard V. Brown, colorfully depicts a time-saving and fuel-saving method adopted by the American Rolling Mill Company. Molten metal is charged directly into the open hearth furnace. This modern practice materially reduces the time required to make a heat in the open hearth furnace and also effects quite a saving in fuel over the old method of charging cold pig iron.

New Ways to Make Money

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ACROSS THE EDITOR'S DESK

WITH the present issue the SCIENTIFIC AMERICAN enters its 87th year of recording the progress of the world of science for an international audience. And since this issue will reach our readers during the holiday season, we take the opportunity to extend our best wishes for A Merry Christmas and A Prosperous New Year to all.

●

Among the advance proofs of the articles in this issue we find one set which is most intriguing. These proofs are of the article which deals with the subject of the X-ray analysis of crystalline structures. A scientific curiosity only a generation ago, the uses of the X ray have multiplied rapidly. Now as the result of a new technique, the same ray that is of such great assistance to the surgeon promises to become an invaluable asset to the engineer. The author of the article, Dr. Pullin, is well known in England for his scientific researches.

●

The artificial production of life is still a moot question among men of science. Down in Mexico, however, there is an earnest research worker who has produced what is at least very much akin in appearance to simple low forms of life. Just what will come of this work only time will tell; for the present we record his results without further comment.

●

Many of our older readers will probably remember, back in the early eighties, when the island of Krakatoa in the Sunda Straits burst its volcanic shell with a boom that was heard for thousands of miles; the huge wave that was formed inundated many villages and towns and took a vast toll of lives. Now old Krakatoa's "offspring," Anak Krakatoa, has been following in its forerunner's footsteps; to date the pyrotechnics have been stupendous but no harm has been done. A series of aerial pictures of Anak in action appear in this issue.

●

Only a few years ago the man who drove an automobile at 40 miles per hour on a public highway was looked upon as at least reckless if not an absolute menace to the lives of others. Today, however, so great have been the improvements in automobile and highway construction, 40 is considered only a moderate cruising speed and 50 and 60 are commonly attained in the ordinary course of driving. In fact one well-known car, equipped with a four-speed transmission, is reputed to do 65 miles per hour in third gear. All of which is a prelude to the announcement that February will be our annual Automobile Number and that it will contain advance information on the developments in motor cars for 1931.

●

While it is quite possible to put a new car or a new part or accessory on the market and let the public find its weak points, that is no longer the way in which the reputable manufacturer works. Instead, he does his own testing, his own fault finding. On his proving grounds he puts new cars or new parts through tests more gruelling than they will ever receive in ordinary service, and redesigns and rebuilds until the resulting product is as perfect as present knowledge can make it. An article on this testing work, different from anything that we have published heretofore, is scheduled for our February issue.

●

We are also collecting material for an article on up-to-date motor camping trailers which may give you an idea for a vacation next summer that will provide a freedom far greater than is possible when your travels must be governed by hotel reservations.

●

One of our editors was a guest at a recent demonstration of ordnance at Aberdeen Proving Ground, Maryland, and the article which he has written on the subject contains some amazing information as to the applications of science to our ordnance problems. Concerning guns primarily, this article also describes developments in our mechanized military forces, motorized gun mounts, tanks, and so on.

●

Although automotive articles will predominate in our February issue, they will not make up the entire content of the magazine. Features on other subjects will cover engineering, building construction, pure science, industry, and aviation. Grouped under the heading of The SCIENTIFIC AMERICAN Digest there will be a carefully selected series of short items that will reflect tersely yet accurately the latest developments in every branch of industry and science.

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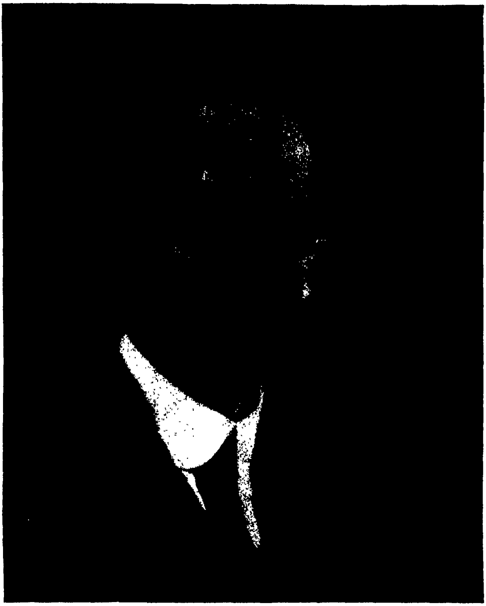


T. H. MORGAN

DR. T. H. Morgan, Director of the Kerckhoff Laboratories of the Biological Sciences at the California Institute of Technology, whose Presidential Address at the annual meeting of the American Association for the Advancement of Science held this year at Cleveland during the Christmas holidays no doubt will receive widespread notice, is the foremost living investigator of genetics and is also regarded by many other scientists as America's ablest man of science. In addition he is President of the National Academy of Sciences, the highest honor any American scientist may receive. Thus he is at the same time head of both the most select and the largest of our scientific bodies.

Professor Morgan's contribution to human knowledge is an understanding of much of the problem of heredity, and the isolation of principles which underlie and guide the practical work of plant and animal breeder Therefore he is a key man to civilization i a large way. "The reader may never ha seen this man," says Scott, "yet this grea work whose successful solution he has chiefl led has inevitably touched often on yo life. The discovery of the mechanism heredity, the mechanism of the genes the germ cells, has enabled other worke to breed cows that give more milk, he that lay more eggs, wheat of higher yield and better quality, corn with more sugar, sheep with more wool and better meat. In sheer economic value alone Morgan has literally been worth billions."

The mechanism of heredity has been explained perhaps best by Professor H. S. Jennings in his recent semi-popular work "The Biological Basis of Human Nature." Morgan's own writings are more technical.

THE "INHABITED WING" PLANE OF THE GERMANS

CARRYING a useful load of two tons, this gigantic new Junkers monoplane *G-38* has, it is claimed, a flight range of almost 3000 miles. Due to its peculiar construction, as shown in this diagrammatic drawing, passengers will have spacious accommodations; and a great quantity of freight or mail can be carried in the thick wings which also contain fuel tanks, the four motors, and has wide passageways for the convenience of the mechanics who will attend the motors. The principal use to which such planes will be put will no doubt be in carrying perishable or fast freight for long distances rather than large numbers of p

Loading ivory at Zanzibar, the old Arab capital on the East African coast. The tusks are first carried on the porters' shoulders to the small boats, then transferred to the lighters which are towed alongside the ship at anchor in the roadstead

IVORY, THE PEARL OF THE FOREST

By ERNST D. MOORE

IVORY, for its grace and beauty, its use for the purposes of art and adornment in all lands for many centuries, for the intensity and persistency of the quest for it and the bloodshed and suffering attendant on its acquisition, may well be classed with gold and precious stones. It has ever been a material associated with the history, romance, art, development, and industry of the world from the earliest times of which mankind has left a record; it is a synonym for luxury and beauty in civilization and of barbaric splendor in the savage countries of the world.

The work of one of the earliest artists of whose product we have any example is scratched on a few broken bits of prehistoric ivory: pieced together they show the picture of a hairy mammoth, sketched by a human contemporary of the animal.

Solomon, so *Kings* and *Chronicles* tell us, had "a great throne of ivory," and to him came "the ships of Tarshish, bringing gold and silver, ivory, and apes and peacocks." Ezekiel pictures the craftsmanship of ancient Tyre in telling of its "benches of ivory inlaid in boxwood," and Pliny said the galleys of Tyre had benches made of ivory. The ancient Hebrews trafficked in ivory with Assyria; and in the days of Thothmes III, 14 centuries before Christ, cargoes of ivory from Abyssinia drifted down the Nile. The *Iliad* speaks of ivory studding on the trappings of horses, and the *Odyssey* of the bosses of shields and the handles of keys being made of ivory, and of roofs inlaid with "the spoils of elephants." The statue to Jupiter Olympus, wrought by Phidias of ivory and beaten gold, was among the seven wonders of the world.

Hundreds of similar examples might be cited; it has truthfully been said that the use of ivory has been so constant and universal as to involve the world's art and history in all ages.

THE supply of ivory has had some curious fluctuations. The Romans put it to such reckless use that by the beginning of the Christian era the then-known sources of the precious material were almost completely drained, whereas only a few centuries before, according to Polybius, it was so plentiful in Ethiopia that tusks were used for stockades in the fields. After the fall of Rome and through the Middle Ages the demand subsided greatly; then as the art and culture of the Renaissance revived it, the Portuguese discovered new fountain heads of ivory tusks in their voyages along the central and southern coasts of Africa. The Portuguese in turn drew such immense quantities of ivory that by the middle of the 17th Century the available supply was almost exhausted again; but a little later the Dutch began to collect ivory in their South African settlements, and the supply rose again. Since then, with the exploration and opening up of the central portion of the continent by the Arabs, British, Belgians, and Germans particularly, ivory has fairly held its own with the demand for it.

There are various types of ivory, notably that of the elephant, its predecessor the mammoth, the hippopotamus, and the walrus, but in this article we use the word to describe the substance generally understood by the term—elephant ivory: the qualities, the quantities available, and the use of other kinds other than that supplied by the elephant have always been negligible in comparison.

The tusks of the elephant are, in the ivory trade, known as "teeth," and this designation is a correct one, for they are the upper incisors of the animal. They grow during the entire lifetime of the elephant, both outwardly, so that the solid portion protruding from the head becomes increasingly longer and thicker, and inwardly, as the part which is set in the skull, about one third the length of the average tusk, contains a pulp chamber which gradually becomes shortened and constricted as the beast ages. A nerve runs the length of the tusk, the canal of which usually is visible as a black speck at the pointed end of the tusk. It is this same nerve canal that is visible on opposite sides, in the exact center, of an ivory billiard ball. Along this nerve, abnormal growths known in the trade as "beans," and other

One tooth of the largest pair of elephant's tusks on record. This great tusk is now in the British Museum of Natural History at South Kensington, in London

evidences of disease which must cause the animals excruciating pain, are often found; so if we have jibed at the giraffe with a sore throat, let us pity the elephant with a toothache!

***Above:* Weighing ivory in the compound of an American trader's establishment in Zanzibar. *Right:* An ivory poacher's caravan crossing a stream in the Belgian Congo with their stolen tusks. The ivory in both illustrations was shipped to America and there fabricated into ivory piano keys**

There are many varieties of elephant ivory—"descriptions," as the ivory buyers and workers know them—Asiatic ivory such as Indian and Siamese; the African kinds known by names of their geographical origin such as Abyssinian, Sudanese, Zanzibar, Uganda, Congo, Mozambique, Angolo, Egyptian, Senegal, Niger, and Ambriz; others named for the uses to which they are put, such as ball and bangle; and others with such odd names as Cutch, Gendi, scrivelloes, and so on. All ivory is divided into two great classes, "hard" and "soft." By far the greater portion of the world's ivory, from ancient times to our own, has come from Africa. The supply of African ivory has not only been many times greater than that of Asiatic ivory, but African tusks run larger and are of superior quality. There are large deposits of fossil or mammoth ivory in the tundra surrounding the mouth of the Lena River in Siberia and on the islands nearby, and though the tusks are much larger than the run of elephant ivory, they are largely defective, and of little commercial value so long as a good supply of African ivory may be had. Very little Asiatic ivory is exported from that continent; most of it is used in India for bracelets and bangles for native brides.

So ivory, as we generally know it, comes from the African elephant. Literally millions of those noble animals have died at the hands of those whose only object was to seize the ivory they carried, for the elephant must be killed to secure its jewels, as the tusks poetically have been called. The elephant does not shed them; it requires hours of careful chopping in a fresh kill to free them from the bony sockets which terminate almost on a line with and between the eyes, or the carcass must be left several days until decomposition has advanced sufficiently to permit them to be "drawn" without recourse to chopping.

Various estimates, running from 40,000 to 100,000, of the numbers of elephants killed annually for their ivory, have been made. These estimates, it should be added, were for the years from 1850 to 1900. It is the judgment of the writer, who spent several years in Africa as an ivory buyer, that around his time, from 1900 to 1915, not more than 25,000 African elephants were killed each year; probably the number has been less since then. Any figure of this kind, however, is at best a guess, for not only are complete and reliable export statistics of the *number* of tusks not available in the many ivory outlets of Africa, but no records whatever are kept of the age of the ivory—that is, whether the tusks come from long dead or freshly killed animals. From recollection alone, in Aden, Arabia, where the writer bought tons of ivory gathered as tributes and taxes by Ras Menelik of Abyssinia, very little of it showed signs of having recently been in a living head. On the other hand, in Mombasa and Zanzibar, the two greatest ivory marts on the East Coast, by far the greater proportion of large tusks—those weighing 40 pounds and over, the writer buying none smaller—undoubtedly came from freshly killed elephants, as recently dried bloodstains and tissue attested.

The largest pair of tusks of which there is any definite record weighed 228 and 232 pounds, and came from Tanganyika, then German East Africa, in 1898. Fifty years ago it was not uncommon for a lot of "prime" tusks to average 90 pounds in weight; 20 years ago the average ran about 70 pounds; and now an average of 55 pounds is considered good.

Not only, in the old days, were the tusks stained with the gore of the fallen elephants, but with the life-blood of countless humans besides. The story of the acquisition of ivory in the 19th Century is also that of Africa in the most cruel aspect of all its tragic history. The slave trade and the ivory trade were one, interlocking and interdependent. Probably never in any other land or age did the natural treasure of a continent bring upon it so cruel a fate, over so immense a territory, as was Africa's in the years of the domination of the Arab ivory raiders. They pressed into the deep interior of the continent long before the first European explorers, and with their guns and powder terrorized and conquered, burned, enslaved and stole, throughout a country nearly as large as the United States east of the Mississippi, for decades.

THEY forced the natives, in every conceivable cruel manner, to deliver their accumulations of ivory, enslaved them when they could produce no more, and sold them for more ivory as human meat to the cannibal tribes about; then, since the only means of transporting the ivory was by human carriers—the tsetse fly making the use of beasts of burden impracticable—enslaved still more to carry the ivory to the coast. There the captive survivors of the slave march—it was estimated that not more than one in five slaves lived to reach the coast—were sold along with the ivory tusks they had carried. Without the ivory, so Livingstone and others were told by the Arabs, the slave trade could not pay. Livingstone proposed the placing of armed steamers on the African lakes to enforce a legitimate trade in ivory and thus kill the slave trade at its source.

Today most of the ivory comes from the Congo, the upper Sudan, Tanganyika Territory, and Portuguese Africa. The white traders and British Indians get most of it from the natives, from whom they buy it legitimately or surreptitiously, as suits the market best. In the former case the ivory tax is paid and the tusks follow the regular trade routes, whereas in the latter, they are taken across the line of an adjacent colonial sovereignty and the import duty paid, thus legitimizing the ivory. The natives find a great deal of ivory in scattered tusks and small hoards which the governments take at a fixed nominal sum and then sell to the traders.

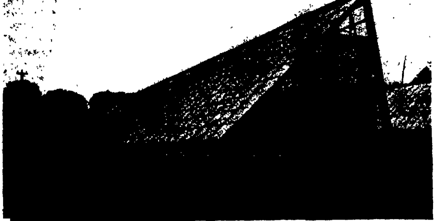
Cutting into blocks across the grain; the first operation in making ivory piano keys

In almost all jurisdictions the natives are allowed, within the confines of the district in which they were born and have lived a requisite number of years, to kill elephants and sell the ivory thus obtained. Sportsmen often sell their ivory to help defray their *safari* costs; government hunters often are despatched to kill troublesome or destructive elephants. Special ivory licenses are often easy to obtain if one is of the right nationality and has a little influence. A great deal of ivory is poached by elephant hunters in the Belgian Congo and Portuguese East Africa and brought over the British line, where, if necessary duty is at hand, there are no questions asked. Thus in many ways, straightforward or devious, the ivory is gathered, and started on its long journey to the working tools of the artisans of civilization.

Shipment of ivory will seem to many to be very carelessly attended to, for despite its great value and its easy susceptibility to damage, the tusks are shipped from Africa without any protective covering of any kind, the bare ivory being stencilled with the shipper's mark, number, and the port of destination. It has been found through long and costly experience that the appeal of the unprotected ivory itself is more potent in ensuring safe handling than any of the forms of covering that have been used.

One knows, of course, that ivory is used for carvings, for cutlery and other handles, for billiard balls, miniatures, and other objects; but, if we except the Indian bangle trade, more ivory is used for piano keys than for all other purposes combined. Ivory, not alone because of the exquisiteness of its contact to the human hand, is the ideal material for the piano keyboard. It is yielding to the touch, yet firm; cool, yet never cold or warm, whatever the temperature; smooth to the point of slipperiness, so that the fingers may glide from key to key instantly, yet presenting just enough friction for the slightest touch of the finger to catch and depress the key and to keep the hardest blow from sliding and losing its power.

THE largest individual users of ivory in the world are the American companies who manufacture keyboards for the piano makers of this country, Canada, and Australia. The center of the ivory industry in the United States lies in two small adjacent towns in Connecticut, on the river which gives the state its name. There is a large ivory cutting company in Buffalo, also. One of the Connecticut ivory cutters, Pratt, Read & Company, of Deep River, is among the oldest surviving manufacturers of any kind in this country, its ivory business having been established in 1806, during the term of Thomas Jefferson, on the same spot where the present factories stand. The photographs of piano key manufacturing were taken in their factories. The few American piano key companies—there are only three—influence almost to a dominating



The ivory wafers are left several weeks in glass houses to whiten in the sun. When one side is bleached the trays of ivory are inverted and the operation is repeated

Matching the ivory into sets of similar grain for piano keyboards

The board with the ivories glued thereon is separated by saws to form the individual keys

extent the price of ivory even in the remotest depths of Africa. At present the cost of a good quality of Congo ivory is about $2.25 per pound at New York.

On arrival at the factories of the key makers, the tusks are stored in vaults, well protected from the light and any extreme changes of temperature and humidity. In the first manufacturing operation they are "junked," or cut across the tusk, to make blocks corresponding to the length of the pieces required for the piano keys. These blocks are then marked by a planner who is expert in the art of getting as many blocks of the broad pieces for the "heads" or front part of the piano key, and the "tails" which are the narrow pieces which run alongside the sharps or black keys, as is possible out of them, leaving at the same time as few wedges of scrap between the head and tail blocks as can be managed. These pieces are then sawed out, and the resulting small oblong blocks are sliced into the ivory wafers that finally cover the piano keys. Each of the sawing operations is done under a stream of water to prevent burning the ivory; the condition of the saws is of vital importance and is watched carefully.

Piano keys and their components: frame, ivories, buttons, sharps, guide pins, capstans

The ivory wafers are then bleached in jars containing peroxide of hydrogen, in the endeavor to make them as uniform in color as possible, for there are many shades and imperfections in a single tusk of ivory. After the immersion is over, the pieces are placed in glass houses which to the passerby seem to be the hot-houses of some horticulturist, and there left to whiten in the sun. From the sun bath the ivory pieces go to a department where, in the north light, they are graded according to their grain and matched into sets for the keyboards.

Meanwhile the wooden board which forms the major portion of the keyboard is being made from sugar pine from the Pacific slope or basswood from the middle West and marked, drilled, and bushed to the particular spacing or "scale" of the piano in which the completed keyboard is to be used. A frame or bed for the keyboard is also made and drilled correspondingly.

At the proper time the ivory and the board meet; a strip of white backing cloth is first glued on the board, and then on the cloth the ivory is glued with a light gray gelatinous adhesive made in France, and set firmly, but with extreme nicety, in a heavy press. Afterward the ivory on the board is planed, sometimes only one or two thousandths of an inch, by rapidly rotating cutters. Then the ivory is polished on buffers.

The next step is the separating of the keys, thus far all together in a single board. Gang saws spaced to the width of the keys in front and band saws for cutting the rearward portion of the keys that swing to right or left to meet the spacing of the piano strings, which is different than that of the front of the keys, are used for this work. Then the pieces which form the bases for the black keys are sent to another department to have the black tops or sharps glued on.

The sharps are made of various materials. They may be of ebony from Madagascar or boxwood from the West Indies, or of native birch. These pieces are stained a deep black in such a thorough manner that if you should cut one of them in two you would find that the wood was stained not merely on the surface but all the way through. This is done by forcing the stain into the wood under pressure in a chamber in which a partial vacuum has first been created. A very fine sharp is made, also, by forming a piece of black celluloid, first rendered plastic by heating, over a core of birch.

After the sharps are glued on, the black keys must find their way back to their own positions in the identical set of ivory keys from which they were parted, and they always do, though the thing appears as mystifying to the outsider as the process by which one finally gets one's own washing out of the steam-laundry's common tub.

THE final steps may be passed over quickly. The sharps and naturals are reunited, the frame is brought up, with its rows of shining pins firmly and accurately set, and on them the keys are fitted and regulated. Then with the final inspection done, the keyboards are shipped off in piano boxes, so that the piano maker who receives them can use the container again in shipping a piano. Soon all manner of human hands, from those which bear the stumbling fingers of practicing childhood to others tipped by the accomplished digits of the virtuosos, are at work on them with varying effects on our peace and happiness.

The making of piano keys is not quite as simple an affair as the foregoing may make it seem to be. Because of the never-uniform quality, texture, and susceptibility of the ivory it is in reality a tremendously difficult, tricky business, to which few set formulas apply, and one which necessarily requires constant expert, individual judgment to overcome the peculiarities of each tusk of ivory used.

If only the elephants would standardize their production, the ivory workers would be happy to do the same with theirs. Since, however, there is no way of inducing the elephant to co-operate, the skill of the workmen must be relied upon for the production of high quality articles from the pearl of the forest.

OUR POINT OF VIEW

Blindness and False Shame

ONE thing that has long irked all men of science is the false sense of delicacy that surrounds the subject of syphilis, the ravager which blinds and kills thousands. This dread disease is not something to be looked upon as the result of sin, a subject to be tabooed; it is rather a powerful enemy that should be treated as such and attacked with all the weapons of science—in the open.

Estimates of a prevalence of syphilis up to 12 to 18 percent have been made for cities such as New York, Paris, and Berlin, but Professor Edward H. Cary, M.D., LL.D., of Baylor University, said, in a paper read before a conference of the Society for the Prevention of Blindness, that he believes this is too high. He estimates that if our total population were examined, 6 to 7 percent would show a positive Wassermann test. This means that that percentage may suffer blindness, may transmit the disease to unsuspecting loved ones, and may bring into the world children that are blinded by syphilis at birth or later in life. Moreover, as every one knows, the mortality in syphilitic cases is high.

Professor C. S. O'Brien, M.D., of the State University of Iowa, said before the same conference that if the disease is recognized in the child during infancy, proper treatment may prevent its effect on the eyes; if not, then very little can be done to stop the process. If it is detected in the mother before marriage or even during early pregnancy, proper treatment of her case will give the child a chance to be born with normal eyes.

Professor O'Brien suggests that a law be passed to compel all persons to submit to blood tests and, further, that all women should have blood tests as soon as they become aware of pregnancy. Of the efficacy of the first, we have our doubts; laws seem nowadays made to be broken. Education of the mass of our population is what we need and that will never be achieved while the present hush-hush attitude prevails. Syphilitic eye defects must be prevented by active educational propaganda.

We believe with Professor O'Brien that syphilitics should not be allowed to marry and that all pregnant women should have blood tests. The stark truth is that no prospective mother knows that she is free of a dormant syphilis; it may be hereditary or she may have contracted it in ways for which she should suffer no reproach nor feel any personal shame. Once it is discovered, immediate and prolonged treatment is necessary.

We have spoken frankly but not indelicately; we have simply stated unalterable facts. The more others speak as frankly, the more chance will scientists have to combat the blindness which occurs as the result of metasyphilitic disease. But while prudery or a false sense of shame covers up the facts, the great destroyer may, like lightning, strike anywhere.

YOUR AID IS NEEDED

INDIVIDUALS, committees, city and state governments, and even certain branches of the Federal Government itself, have, during the past few weeks, worked out praiseworthy plans for the relief of unemployment. Some jobs have literally been created out of nothingness and others are simply jobs that should have been done long ago but were postponed for one reason or another. All in all, the work along this line has been splendid and we commend all those who now have or have had a hand in it.

The problem of unemployment, however, assumes a more serious aspect with the coming of cold weather. If our winter is severe, there is bound to be a great deal of suffering, especially in our cities, for many thousands will lack sufficient fuel, warm clothing, and warm, nourishing foods.

The work of making jobs must, therefore, go on—not half-heartedly but with well-directed vigor. But there is something more which is especially important at this Christmas season. We millions of well-fed, well-clothed ones who have been touched only superficially by the depression—we who have grumbled because we have had to keep last year's cars—must open up our purses as we haven't since the war and must give to the Red Cross, the Salvation Army, the Volunteers of America, and other organizations of a like nature in our communities. And for those people who cannot be classed among the poor that receive charity, we must make more and more jobs.

Too Fat?

BY continuing the "slim silhouette" in women's fashions, dress designers are salting the gold mine which already has enriched purveyors of fat-reducing remedies, most of which are wholly worthless, some, indeed, being harmful.

The Food, Drug, and Insecticide Administration of the Department of Agriculture states that "No drug or mixture of drugs known to the medical profession can be offered for the promiscuous use of the public for reducing weight without introducing an element of danger." In fact, the Administration has record of a case in which death resulted from an overdose of a widely sold anti-fat concoction.

Therefore, whatever your reasons for reducing, do not allow your reason to be seduced by lurid advertisements. Consult your physician and let him prescribe the remedy, if there is one for your particular case, and then follow his instructions conscientiously. It's safer!

International Affairs

Our Peacemaker

WHEN Mr. Hoover was elected it was predicted in some quarters that his long residence abroad would cause him to take a lively interest in foreign affairs; and so it has come to pass. Not content with the results of the London Naval Conference the President is now undertaking through Mr. Hugh Gibson, American Minister to Belgium, to reconcile the conflicting claims for naval tonnage of France and Italy.

The purported reason of our interest in this problem is the fear that England will insist upon increasing her naval program if France and Italy continue to add to their navies, and England's building will cause us to increase our navy or fall farther behind. In short, we must either persuade these two states to decrease their naval programs or spend some more money on our fleet.

The reason given these two states for our gratuitous but friendly advice is that jointly with England we were instrumental in calling the Naval Conference, which has unfortunately caused increased tension in the French-Italian relations and therefore we feel it our duty to assist them in finding a formula for their two navies that will remove this friction.

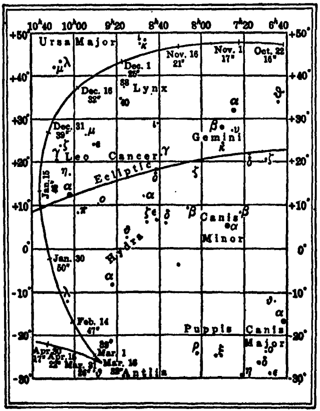
(*Please turn to page* 67)

TESTING THE ASTRONOMICAL YARDSTICK

By HENRY NORRIS RUSSELL, Ph.D.

THE earth's distance from the sun has sometimes been called "the astronomer's yardstick," since it is the unit which he uses in describing other distances. Our best methods for measuring the distances of the planets—and, for that matter, of the nearer stars—do not give an answer directly in miles or kilometers; they tell us how many times the sun's distance or what fraction of it we have to deal with. Hence the accurate measurement of the sun's distance (or to be accurate ourselves, of the mean value of this distance, which varies in different parts of the earth's orbit) is one of the major problems of observational astronomy. Many ways of measuring it have been devised and put in practice. The results agree so well that it is unlikely that the accepted value, 92,870,000 miles, is in error by as much as one-fiftieth of 1 percent.

But even this small margin of uncertainty amounts to more than 18,000 miles, and it would be worth while to diminish it. The best chance of doing so by direct observation that will fall to the lot of any astronomer now living comes at the present time, and an extensive and carefully planned series of observations are already under way at many observatories.



From Russell Dugan and Stewart's Astronomy, courtesy Ginn and Co.

Figure 1: The path of Eros. The figure below each date indicates the parallax, which is explained in the text

TO find the sun's distance we begin by measuring that of a planet—for the ratio of the two can be calculated with all the accuracy we need if once we know the planet's orbit. The nearer the planet is to us the more accurate our measurements will be; for they depend upon the convergence of the lines of sight from various parts of the earth, on the familiar principle of the range finder.

Of all the planets the little asteroid Eros comes closest to the earth and it will be nearer late in January than it has been since its discovery in 1898, or than it will be again until 1975. Why this happens appears clearly from Figure 2. Eros moves in a decidedly eccentric orbit. At aphelion its path is more than 70,000,000 miles outside the earth's orbit but at perihelion the distance is only 13,840,000 miles—which is but a little more than half the distance of Venus.

Such close approaches are rare, for the orbital velocity of Eros at perihelion is almost equal to that of the earth (though in other parts of its orbit it is smaller). If the earth is behind the planet as the two approach the region where the two orbits are nearest it has a "stern chase" and can not catch up with Eros until the favorable region has been passed. On the other hand, if the two planets are abreast of one another at perihelion they will remain so for a good while. This is happening at the present time. Eros comes to perihelion on January 17th. At this time the earth is not quite in line between it and the sun, but we are only five days' motion behind. It takes us a whole month to catch up far enough to get between Eros and the sun, so that opposition does not occur until February 17th. The distance reaches its maximum on January 30th, 16,200,000 miles, and is less than 20,000,000 miles for almost two months.

A still more favorable approach happened in 1894 when the earth was only a day and a half ahead of Eros, but unfortunately this happened four years before the planet was discovered. In 1900-01 the earth was 17½ days ahead and the least distance was a little less than 30,000,000 miles. Hundreds of observations were made on the planet that winter, and the resulting value for the sun's parallax and distance is the best that has yet been obtained by the geometrical method. The planet is so much nearer this time that one night's work should be as valuable as three nights then (with instruments of equal power).

FOUR revolutions of Eros take 16 days longer than seven of the earth. In 1938, therefore, the earth will be 11 days ahead of Eros at perihelion and conditions will be better than in 1901. Reckoning ahead, it appears that in 1968 the earth will be 11½ days behind, and in 1975, 4¾ days ahead; which will give the observers another chance substantially as good as the present, but little better. In the year 2012 the earth will be less than two days behind Eros and only then will the lost opportunity of 1894 be repeated.

The planet's track in the heavens at a favorable opposition is unusual and curious (Figure 1). Its orbit is inclined nearly 11 degrees to the ecliptic, and the node nearly coincides with the perihelion, as is shown in Figure 2. In consequence the planet at this time is moving eastward around the sun at very nearly the same rate as the earth, but is also moving southward or, in the figure, downward through the plane of the paper. For us who watch from the earth the eastward motion is almost neutralized while the southward motion is apparently rapid. Before opposition Eros is far north in Ursa Major (Figure 1). It sweeps southward in a wide curve, crosses the ecliptic about at right angles, and is almost stationary in March in the southern constellation Antlia, almost 40 degrees from the ecliptic and with the declination differing by 74 degrees from what it was in November. The planet's distance decreases from 51,000,000 miles on October 25 to 16,200,000 on January 30, and increases to 50,000,000 before the end of April. It will be nearly three magnitudes brighter at the middle date than on the others. Recent observations show that it is fainter than was anticipated, and at best it will be between the eighth and ninth magnitudes and quite invisible without telescopic aid.

To identify Eros the observer should have a good star chart. It will then be fairly easy to pick the planet out by its rapid motion, which amounts to a degree per day. For the benefit of those who may care to try, this brief ephemeris is given:

	R.A.	Dec.
Jan. 5	10h 28.0m	+23°7′
17	10 31.4	+11°12′
29	10 23.4	— 2°8′
Feb. 10	10 7.2	—13°57′

THE precise observations of the planet which are made to determine the sun's distance, present interesting complications. What we must measure is the planet's parallax—that is, the difference of its direction as seen from the point where each observer happens to be, and from the earth's center (which is adopted as a standard). We can not of course observe it from the latter point, but since we already know the planet's distance very closely we may proceed as follows.

Starting with the present accepted distance of the sun we may calculate that of the planet at any time, and then by straightforward geometry compute just how much the apparent position of the planet as seen from the point of observation at the given instant should differ from the position seen by the hypothetical observer at the earth's center. Applying these corrections for parallax to all the observations we obtain a series of results which, *if our adopted value of the sun's distance was exactly right*, would agree perfectly with the value calculated from the theory of the planet's orbital motion (except for the very small errors which are unavoidable in even the best observations). If, however, our adopted distance from the sun is a little out, this agreement will be disturbed and can be improved by increasing or diminishing the corrections for parallax by a small fraction of 1 percent. Just what alteration is required is found by the method of least squares, familiar to the computer, which makes the outstanding discordances as small as possible.

In this way all the observations made at observatories throughout the world can be combined in a single investigation. The computer will have plenty to do, for in a question of such delicacy he can not put trust in even the best previous calculations of the elements of the planet's orbit. He must determine them anew and find what c rections to them as well as to the parallax will give the best possible representation of the observations of the "campaign." Incidentally, of course, we r verify that the perturbati of the planet's motion by the attraction of all the other planets have been correctly computed.

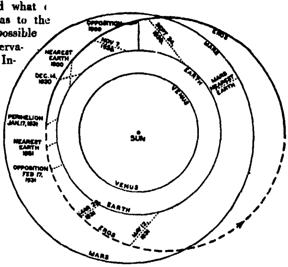


Figure 2: Orbit of Eros. From a special leaflet issued by the *Astronomical Society of the Pacific*

All this is very laborious, but the methods to be employed are well known and it is really only a question of bookkeeping, so to speak. Still more care and forethought are required in order that the observations themselves shall be free from all avoidable errors. Observers for stellar parallax need not bother themselves with a precise determination of the actual right ascension and declination of their stars —the *relative* positions of the stars in the photographed field tell them all they seek. But in the present case, where the planet wanders far over the heavens, the stars around it will be quite different from day to day and it becomes necessary to know their places with great precision. A long series of "reference stars" distributed all along the apparent path of Eros was therefore picked out years ago, and these have been carefully observed at many places so that their positions are now among the most accurately known in the heavens. Photographic methods will add many fainter stars to this list. If the astronomer who photographs Eros can find four or five of these stars on his plate he can measure the planet's position, using these as standards, and have full confidence in his results. It may be possible to guide on the planet, which will then show a round image while the stars appear in trails. Which of these methods will give the most accurate results can be found only by trial.

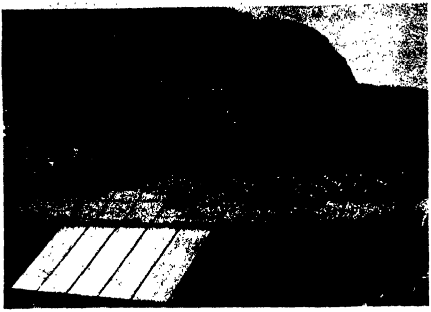
FINALLY there is a subtle error arising from the colors of the stars. Refraction of light in the earth's atmosphere shifts the stars' apparent place in the sky and shifts a blue star more than a red one. If the planet's light is redder than the average for the stars there will be a resulting average shift which, though small, is very troublesome since it acts always in the same direction as an increase in the parallax. The spectra and hence the colors of the reference stars have therefore been observed so that observers can avoid stars of extreme color, or perhaps balance a red one with a blue one.

One other thing besides the sun's distance should be very accurately determined by this campaign and this is the mass of the moon. As the moon circles about the earth every month the earth's own center swings in a small orbit about the center of gravity of the two bodies. The distances of the two from the center of gravity are inversely proportioned to their masses.

This motion of the earth's center is of course allowed for when predictions are made of the apparent motions of the sun or the planets. If the value at present adopted requires any alteration its amount can be found from the observations of Eros by introducing this correction also into the solution, like the correction to the parallax. To get a good determination the observations must be continued for some three months, so that the "lunar equation" may swing from positive to negative and back again several times.

Many observatories throughout the world will engage in this campaign and, indeed, are now actively at work upon it, taking all the precautions here described and various others which we have not space to tell of. Most of the work will be photographic, as is always the case nowadays. Before spring comes thousands of plates will doubtless have been exposed. Measuring them will be a long job and discussing the results a longer one, so that it may be fully ten years before the final result is announced.

After this sketch of what is involved in the present Eros campaign it may be hoped that the reader will not reproach astronomers for the delay. Numerous other astronomical problems have involved longer periods of application, even, than this.—*Princeton.*



Three stages of construction of the Salt Springs Dam—the dumped stone, the hand-placed stone, and the a slab of the upstream face

A STONE DAM GREATER THAN CHEOPS' PYRAMID

By P. M. DOWNING

Vice-President and General Manager, Pacific Gas and Electric Company

A DAM as large as the pyramid of Cheops, wonder of the world for thousands of years, is the modern miracle of industry which features California's latest great hydro-electric project.

Literally moving mountains for its purposes, the Pacific Gas and Electric Company is constructing at Salt Springs high on the Mokelumne River in the Sierra Nevada, the largest rockfill dam in the world. Nearly 3,000,000 cubic yards of granite are being massed across the canyon of the Mokelumne River, in a mighty structure which rises 330 feet from the river bed, extends 1300 feet at its crest from one canyon wall to the other, and measures 900 feet through at the base.

The Pharaohs spent a lifetime in constructing their pyramids. The California power company is spending two years in constructing its dam.

Two years to move 3,000,000 cubic feet of mountain means that 125,000 cubic yards of granite must be quarried and dumped each month. Moreover, this tremendous task, involving the blasting of mountain sides, transportation of mighty rocks weighing as much as 25 tons, and settling these stones in their places on the mammoth structure, is being carried on in the remote fastnesses of unbroken mountain country, 50 miles from the nearest railway, where not even crude roads had penetrated before the power company surveyors.

Preceding the actual period of construction on the dam, the builders carved roads, extended power lines, constructed camps, and in other ways made provision for the use of modern machines, for the transportation of supplies, and for the housing of the small city of men required to carry on the work.

A portion of the tunnel built to divert the river. It was excavated through a mountain of solid granite

The character of the high Sierra country in which the work is taking place adds to the difficulties of the builders. It is a country of solid granite, rising in bluffs which have been compared to the famous walls of the Yosemite Valley, and descending precipitously into the canyons of its many water courses. Two years, with enforced halts during the winter period of heavy snow, were required in the building of a 30-mile road in that granite country. This road had to be carefully constructed to stand the wear and tear of three years' constant traffic, during which more than 50,000 tons of cement, steel, machinery, and other supplies were to be hauled to the construction site.

ONE supply does not have to be hauled in—the stone for the dam. An abundance of excellent quality granite for quarrying is right at hand. In the building of an ordinary gravity type concrete dam, about 150,000 tons of cement would have had to be brought in to do the work of this stone. Granite cliffs at the dam site provide the rock supply and it is from these cliffs that the stone is blasted away and poured down into the river's chasm.

Every modern construction convenience is available to the 1600 men who are now working on the project here in this isolated region. Electricity is available for all power operations, lines having been extended to this location from the nearest point on the power company's system, 40 miles away. This line was used even for road construction.

Machinery which has been developed during the course of many years' experience in the west is available for this newest project. Additional equipment has been worked out to meet the peculiar problems of this job, which is new and unusual in many of its features.

Construction at the dam site itself began in 1928, and is to be completed during the summer of 1931. Most important of the preliminary tasks were the excavation of a tunnel, 19 feet in diameter, through the granite mountain on one side of the proposed structure to permit the diversion of the river during the period of construction in the river bed; and clearing away the river bed to the solid foundation. About 310,000 cubic yards of loose rock and other debris were removed in stripping the dam site to bed rock.

Then began the two-year

process of pouring rock into the fill. Stone was dumped from both abutments, gradually blocking up the canyon. On the downstream face the rock was allowed to roll to a natural angle. The upstream face, which must withstand the pressure of 130,000 acre-feet of water in the gigantic reservoir to extend four miles back of it, is being faced and sealed with placed stone and concrete.

Three main quarries are located on the north side of the dam. On the south side, excavations for a spillway provide about 500,000 cubic yards of rock. An average haul of about 1500 feet is required between quarries and the fill. This transportation is carried on by tractor-drawn trailers of nine cubic yards capacity, from the spillway quarry. Thirty-cubic-yard railroad cars, drawn by electric locomotives, haul the rock from the north quarries. Both side-dump and end-dump cars are used, the latter being one of the innovations which have been worked out on this job. The cars are loaded by electric shovels.

QUARRYING here is spectacular. The first step in the process is to break off a great slice of mountain. To accomplish this, a line of vertical holes is drilled 60 to 180 feet deep, 20 feet apart, and 30 to 45 feet back from the face of the cliff. Across the base of the ledge, horizontal toe holes are drilled about 24 feet back and approximately eight feet apart. These holes are loaded with explosive, the blast is touched off, and a section of the mountain crumples.

The largest of these blasts was set off last November, when a granite face 160 feet high, 45 feet deep, and 750 feet long was shattered into 231,700 cubic yards of broken stone in a single explosion. In preparation for this blast, 44 vertical holes 158 feet deep, and 99 toe holes 24 feet deep, were loaded with 116,250 pounds of Hercules dynamite. Products of big shots such as this are further broken up by blasting into sizes convenient for handling.

Facing the dam on its upstream slope makes up a large part of the construction task. A layer of placed rock, 15 feet thick, covers the entire slope, and each stone in this facing must be handled separately. Five crawler cranes, which have been converted from power shovels, are used for this work. With wire rope slings, these cranes handle rocks weighing as much as 10 tons.

The large rocks are chinked with smaller stones, the whole making a solid face for the concrete slab which is later poured over the surface. At 60-foot intervals, grooves are left in the placed rock sections, which allow for concrete ribs under the edges.

Thickness of the concrete slab varies from 36 inches at the bottom of the dam to 12 inches at the crest. One of the new construction methods of this project was developed for the pouring of this slab. This is the use of a sliding steel form instead of a stationary form. The slab is poured in sections 60 feet square, the edges of the panels resting on the concrete ribs provided for when the grooves were left in the placed rock section. The entire section is completed in one continuous pour taking about 12 hours.

Completion of Salt Springs Dam will be the first step in a great hydro development project which is to provide electric generating capacity of 228,000 horsepower on the Mokelumne River. The reservoir to be formed by this dam is to be the main storage body for four generating plants at lower levels.

The entire development will not be completed for a number of years, but the first units will go into operation in the summer of 1931. Construction of two power houses and auxiliary facilities is going on simultaneously with the building of the dam. Salt Springs power house, at the foot of the dam, is to have a capacity of 15,000 horsepower when it first goes into operation. Twenty miles down the River is Tiger Creek Power House, an 80,000-horsepower plant which will be completed at the same time. Concrete canal and tunnel will carry the water from Salt Springs to Tiger Creek.

Two other power houses are to be built below Tiger Creek eventually, and an additional capacity of approximately 35,000 horsepower is to be added at the Salt Springs Power House later.

Approximately 40,000,000 dollars is being spent on this great hydro-electric development, which is the newest project of the Pacific Gas and Electric Company, California's largest power utility and third largest service company in the United States. Increased electrical facilities being developed by this company will benefit a territory of approximately 75,000 square miles extent and upwards of 1,200,000 households, factories, farms, and shops.

One of two four-yard electric shovels used on the job. Operated by a single man, this shovel loads rocks weighing up to 25 tons on the cars

Previous shots have already torn away much stone from this cliff. Holes have been drilled and loaded for another

The same cliff "erupting." When this blast was made, stone totalling 231,700 cubic yards crumpled from its face

HAS LIVING MATTER BEEN PRODUCED IN THE LABORATORY?

By MAYNARD SHIPLEY

President, The Science League of America

IF the "discovery" announced and discussed in this article is confirmed by other men of science than the one who has made it, its date of publication will mark the beginning of an epoch, not only in biochemistry but in biology, and may be the beginning of the end of certain schools of thought and philosophy. It will signify that in the summer of 1930, possibly protoplasm was produced from inorganic matter by aid of photosynthesis, or solar chemistry, in the laboratory of a Mexican biochemist—one whose intensive labors in the provinces of biochemistry, biophysics, and related subjects, extend over a period of a quarter of a century or more. Even if—as seems more probable—only the first close approach to this great discovery has as yet been made, the announcement is an important one.

In January 1929, readers of the SCIENTIFIC AMERICAN were made acquainted with the remarkable success attained by Dr. Alfonso L. Herrera, then Director of the Biological Institute of Mexico, in the production of certain inorganic bodies closely resembling living organisms, not only in form, but in behavior. The likeness pertained not only to forms and structures but also to lifelike cell phenomena: *for* example, the imitation of cell division, the formation of "nuclear bodies," spindle formation (the "mitotic" figure), extension and retraction of pseudopodia or temporary feet (in amoeba-like forms), and so on. In order to distinguish these purely chemical structures from living forms, Dr. Herrera gave them the name of "protobios," and, later, of "colpoids."

PHOTOSYNTHESIS—chemical synthesis due to the effects of sunshine—played no part in the production of these more or less lifelike inorganic structures. More recently, however, Dr. Herrera has given increasing attention to experiments in photochemistry. During the past five years, the present writer has been in constant touch with the progress of this brilliant and indefatigable biologist and biochemist; and on August 22, 1930 (which may some day be a memorable date), Herrera wrote that he felt justified at last in announcing that he had produced protoplasm from inorganic materials—or, at least, a substance which he could not distinguish from protoplasm. The forms incidentally produced include bacteria, fungi, "connective tissue," and what appear to be simple protozoa.

Dr. Alfonso L. Herrera and three able laboratory assistants, his wife and daughters. *Left:* Lucia Herrera. *Below:* Maria Estrada y Herrera. *Right:* Maria Amalia Herrera

While these apparently living forms may be merely lifeless bodies with a startling resemblance to certain typical, though low, forms of life, Dr. Herrera is confident that he has seen evolve before his very eyes that complex of organic compounds called protoplasm, upon which all life is dependent. He is, however, careful to say that he does not care to assert, as yet, that his protoplasm is "complete and living." It suffices for the present to say that a great step forward is believed to have been made in physical chemistry, through the synthesis of a product not readily distinguishable from protoplasm.

ON the face of his reports, as made to me in August and September, it certainly would be imprudent to jump to any definite conclusion, either for or against. One's first impulse naturally is one of incredulity, considering the apparently insuperable difficulties involved. But few who are conversant with the progress made during the past five years or so toward the production of living matter from so-called dead elements and compounds doubt that science is very near one of its goals—the production of living matter by the chemist in his laboratory.

I shall attempt to show in the discussion which follows that Herrera's results are not isolated, but may be taken as representing the logical next stage in work that has been going forward during the past 60 or more years.

How close to actual living organisms are the forms produced by Herrera? It is the very perfection, structurally, of the vegetal (?) and animal (?) forms and tissues revealed by his powerful microscope that gives us pause. They are a bit too far advanced, one would think, to be representative of primitive life forms, and unless we are prepared to go back to the innumerable experiments of Dr. Charles Bastian and his heterogenetic findings, and, in a sense, begin all over again, we are all but compelled to assume that the forms and phenomena observed by Herrera do not represent primitive forms of life—or even of near life—but are due merely to accidental resemblances to living organisms. However, this may be a mistaken view of the subject. It is unfortunate that the photomicrographs reveal so little of the delicate structures seen directly under the microscope. (Dr. Herrera was good enough to send me some actual specimens for microscopic study.)

A brief résumé of some of the work accomplished by his predecessors will aid in an intelligent evaluation of Herrera's present results.

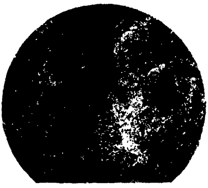
Speaking of his astonishing products, Herrera says: "It is confirmation of von Baeyer's theory which you quote in one of your published works." It was von Baeyer who first suggested that the initial stage in the synthesis of organic matter from inorganic, by the green leaf (when exposed to radiant energy), consisted of a reaction in which a molecule of carbon dioxide of the air was "seized" and the oxygen removed, forming, in the presence of a molecule of water, formaldehyde, the simplest possible of the carbohydrates. The oxygen thus produced is merely a by-product, as suggested by Priestley and Ingenhausz a century earlier.

These chemists noted that when the green substance of the leaf, "chlorophyll," was exposed to sunlight, it gave off oxygen from plants containing it. About 1865, Sachs, professor of botany at Würzburg, came to the erroneous conclusion that the first organic product formed in the leaf was starch, and that the production of this carbohydrate took place most vigorously when the leaves were exposed to the yellow-red rays of sunlight. Later research led to the conviction that cane sugar ($C_{12}H_{22}O_{11}$) was the first product. Then von Baeyer, professor of organic chemistry first at Munich and later at Berlin, put forward his formaldehyde theory, which still holds the field, though not without criticism at the hands of that eminent American biochemist, Dr. H. A. Spoehr. However, most workers, for example, Benjamin Moore, Daniel Berthelot, E. C. C. Baly, Webster, Heilbron, Barker, and others, accept the theory of von Baeyer.

VON BAEYER explained the production of carbohydrates (starches, sugars, cellulose) by a primary formation of formaldehyde. Carbon dioxide plus water forms formaldehyde plus oxygen, by means of light rays, in the presence of the green pigment, chlorophyll, found in the leaf of the plant. Note that only three elements are present—carbon, hydrogen, and oxygen. But formaldehyde has a strong tendency to add to itself, or combine with itself, more of the same species of atoms or elements. In the green leaf of the plant, under the influence of radiant energy acting on the chlorophyll, it multiplies its original formaldehyde molecule by six, but adds no new element, thus changing from formaldehyde (familiar as the disinfectant and preservative called "formalin") to grape sugar. Cane sugar can be formed synthetically from a mixture of glucose and fructose by eliminating a molecule of water. Starch is produced by the plant from glucose, direct, also by condensation.

But what of protoplasm, which Herrera thinks he has produced photosynthetically? The formation of living matter, as the physiologist knows it, consists in the synthesis of the proteins, nucleins, fats, and carbohydrates of the cells, from the "split products," of which I shall speak presently. Of the three classes of organic compounds, the most complex are the proteins. Their chemical structure is based principally upon nitrogen. The proteins are readily broken down or "split" into a number of constituents or units, known as "amino-acids," containing hydrogen and nitrogen. The amino-acids all possess the properties of both acids and bases, and the different proteins found in different kinds of living tissue are made up of amino-acids combined in different proportions.

In 1883 Curtius was able to synthesize certain elements which yielded a substance whose chemical reaction was characteristic of protein products. The proteins, or proteids, form the essential basis of protoplasm, and consist, as said, of nitrogen, hydrogen, carbon, and oxygen; some of them also contain phosphorus and sulfur. They form a thick, viscous solution in water, what is known to the chemist as a colloid solution, or "sol," which on very slight provocation passes into a gelatinous solid, or "gel." This complex mixture of sol and gel, together with the compounds mentioned above, is what is meant by the term "protoplasm"; and it is this substance, or something much akin to it, which Dr. Herrera has produced from a few simple inorganic elements, by photosynthesis.



Resembling alveolar structures

Soon after Curtius built up in the laboratory his protein products, Emil Fischer showed that both plant and animal proteins could be split up into amino-acids; and he devised methods of combining these substances, linking them together into complex bodies—polypeptides—resembling the peptones which are produced by the action of digestive ferments on proteins. These bodies are regarded as probable stages in the construction of the complex which we call proteins, bodies essential to the formation of protoplasm.

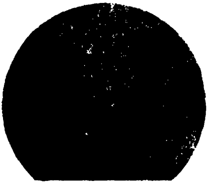
Forms suggesting division of amoeba

Skillful biochemist as he was, Fischer could not, by synthetic methods, produce protoplasm; nor, for that matter, starch or cellulose. The most he succeeded in doing was to produce the polypeptides. But radiant energy can—and does—do what no chemist in his laboratory can accomplish by his limited methods. In some manner light vibrations transform the molecular complexes and produce the chemical energy requisite for the changes brought about.

The late Dr. Benjamin Moore demonstrated conclusively that dilute solutions of nitrates exposed either to sunlight or to an artificial source of light rich in light energy of short wavelength, undergo conversion of nitrate into nitrite. This reaction, like that of the formation of formaldehyde by transformation of the energy of sunlight into chemical energy, involves an uptake of chemical energy similar to that which takes place in green leaves when organic carbon compounds are formed. Dr. Moore's results show that, while rainwater which has been held for a considerable time contains no nitrites (all having been oxidized to nitrates), if this same water be exposed to bright sunlight or ultra-violet rays for a few hours, a strong reaction for nitrites is always obtained. Not only do the nitrites contain a greater storage of chemical energy than the nitrates, but the nitrites react more readily than the nitrates, and many changes occur between living organisms and nitrites which are not given directly by nitrates.

BALY, Heilbron, and Hudson have succeeded in producing complex nitrogenous products from inorganic substances under the influence of ultra-violet light alone. Baudisch long ago (1911) obtained evidence of the formation of amino-acids by the action of ultra-violet light on a potassium nitrite solution in the presence of carbon dioxide with ferric chloride as a catalyst; and in solutions of potassium nitrite and formaldehyde exposed to ultra-violet light, of an alkaloidal compound similar to nicotine. Baly, Heilbron, and Hudson not only obtained similar results, but also obtained from inorganic materials two different complex organic substances, "one a volatile oil and the other a low-melting solid, both of which give crystalline salts with acids and positive tests with the usual reagents for alkaloids."

As is well known, hundreds of thousands of organic compounds have been built up in chemical laboratories since the days of Liebig and Wöhler—the latter (1828) was first to synthesize an organic compound, thus disproving the old doctrine of "vital force." The problem today of the artificial production of living matter does not consist, however, of the synthesis, atom by atom, or molecule by molecule, of inorganic elements into living cells at the hands of the biochemist. The work of Moore and Webster, of Barker, Hudson, Baudisch, von Baeyer, Butlerow, Stoklasa, and other researchers, goes far to show that the "creation" of living matter, now or in primordial days, is a function of radiant energy acting on suitable materials, wherever and whenever found. It has been discovered that while all the rays of light, from infra-red to ultra-violet, are of biological importance, the ultra-violet radiation is the chemical radiation *par excellence*, while the relatively long waves, such as the infra-red, are especially concerned with assimilative problems, both in plants and in animals.


Bearing resemblance to mitotic forms

It has been fully demonstrated that the high-frequency rays, for example ultra-violet rays, are analogous in their effects to high temperatures in the chemical laboratory. This explains the fact that living organisms produce without high temperature chemical products which, synthesized in laboratories, would require thousands of degrees of heat.

In France, M. Daniel Berthelot, in co-operation with M. Gaudechon, conducted valuable researches concerning the effects of ultra-violet light on various materials. These experiments succeeded, by the aid of photochemistry at high frequency, in "reproducing the fundamental mechanism of the restoration of chemical energy which we find in nature, that is, the mechanism of chlorophyllian assimilation."

In England, endothermic synthesis, that is, synthesis involving heat absorption, was carried out by means of the quartz mercury-vapor lamp, resulting in the production of carbohydrates from carbon dioxide and water-vapor. By this means Berthelot succeeded in synthesizing a new compound, $CO(CN)$. Decompositions also were effected, and the principal types of fermentation reactions were carried out.

Using, as a basis, inorganic gases of the simplest character, for example, carbonic acid gas and ammonia, the high-frequency rays give rise to formamide.

The syntheses mentioned bring us up to the starting point of the proteins and albumins, the basis of living matter.

Now comes Dr. Herrera with the announcement of the next step in photosynthesis; the apparent production of protoplasm itself. It may be, of course, as said previously, that what Dr. Herrera interprets as protoplasm is something else. But what? To repeat one or more of his experiments would be a simple matter for any chemist. The materials and the procedure, in a typical instance, are as follows as stated by Dr. Herrera:

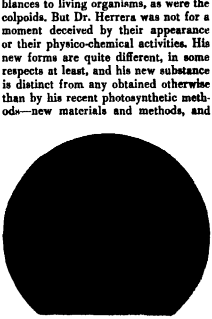
PLACE a plate of glass moistened with formaldehyde on a closed glass dish or Petri dish enclosing 20 cubic centimeters of sulfide of ammonia dissolved in five percent of water. Place in strong sunshine from 8 A.M. to 6 P.M. Microscopic examination will reveal the transformation of the solution into what appear to be vegetable tissues, cells with two nuclei (some of which may be blue), an abundance of structures resembling microbes, amoebae, yeast, alveolar appearances, parenchyma, and, in short, all the marvelous, in some cases lace-like, structures characteristic of indubitable protoplasm. Formaldehyde, or monose of Fischer, precipitates "sulfide of sulfur" (?—"*soufre de sulfure*") in a remarkable state of division. Herrera is inclined to believe that "sulfur is, rather than silicon, iron, or the amino-acids, the base of life." At least, that is his impression "deduced from weeks of experimentation" with the materials here mentioned.

The successive reactions that occurred in the case of Herrera's materials, under the influence of sunlight, lacked the vegetable (leaf) substance known as chlorophyll, which in the plant acts as transformer of solar energy, producing sugar and finally starch and cellulose. Herrera's product was not sugar but apparently protoplasm. He writes:

"It is no longer a question of *imitations* of protoplasm, but of protoplasm prepared with reagents uniting with already complicated combinations of molecules, producing, probably, sulfaldehyde, nitrosilicon, hexamethylin, formhydroxamic acid [*sic*], and what not?"

And here is another phenomenon which seems to be unprecedented in the work of his predecessors: the organic structures produced are volatilized by calcining, being formed particularly from sulfur; but between two glasses the calcining leaves a carbon residue. A repulsive odor of organic substances, not yet identified, arises. With iodine added, black or perhaps intense blue globules appear.

WHILE it is true that we may, for the time being at least, place the recently produced photosynthetic "organic" forms among this investigator's "colpoids" (which were produced without the aid of sunshine), it is not so easy to dispose summarily of the assumed protoplasmic substance. If it is not protoplasm as we have heretofore identified this living substance, it may possibly represent an intermediate stage in the evolution or synthesis of what Huxley so long ago called, quite correctly, "the physical basis of life." The *forms* may be accidental, chance resemblances to living organisms, as were the colpoids. But Dr. Herrera was not for a moment deceived by their appearance or their physico-chemical activities. His new forms are quite different, in some respects at least, and his new substance is distinct from any obtained otherwise than by his recent photosynthetic methods—new materials and methods, and novel results, but wholly consistent with the less sensational results of his predecessors.

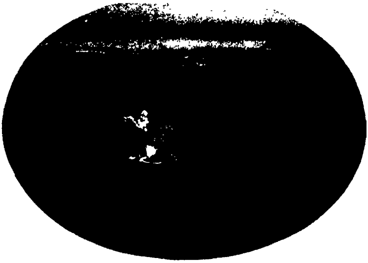

Like protoplasm, vacuole granules

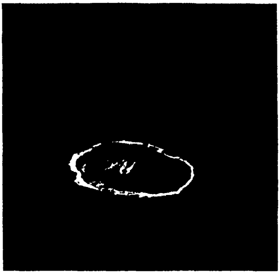
All this may seem, superficially, not very convincing as to the photosynthetic production of veritable protoplasm. Nevertheless, so far as I can learn, no similar phenomena have ever been produced by any other worker in this field.

Perhaps enough has been said to bring home to the reader how far the age-old gap between inorganic, non-living compounds and living protoplasm appears to have been narrowed or even obliterated.

THE VOLCANIC BIRTH OF A NEW ISLAND

e of Krakatoa hurls aloft
to a height of 1000 feet





Little "wisps" of steam (actually 300 feet high) where the sea has broken over the crater's rim

Another distant airplane view, showing a cloud of steam and cinders hundreds of feet high

In the background is one of the island fragments of the edge, or ring, of the crater left after Krakatoa's explosion of 1883

WILL the volcano of Krakatoa repeat the great explosion of 1883? Millions who live within reach of its ever-threatening long arm in the Far East would be thankful for a dependable answer to this question. Science, too, would like an answer.

In the great event of 1883, this volcano, lying in Sunda Straits between Sumatra and Java, suddenly blew into fragments and hurled into the air a cubic mile of comminuted matter. The original volcanic island, five miles in length, three miles in width and 6600 feet high, was replaced by a vast submarine trench eight miles long and more than 1000 feet in depth. The explosion was heard 3000 miles away and its air wave traveled several times around the earth, while the great seismic sea wave devastated the islands in the vicinity, drowning 36,000 people. This wave traveled across the Indian Ocean at the rate of 371 miles per hour and was recorded even at Cape Horn and in France. No record of an explosion as vast as Krakatoa's exists in human history.

Then Krakatoa slept for 44 years. In 1927 signs of a reawakening commenced. An eruption occurred in the deep trench 1000 feet below the water, volcanic bombs were hurled to the surface and 4000 feet into the air. Those who dwell in the vicinity were apprehensive.

Last summer, as shown above in the group of photographs here reproduced by courtesy of the *Illustrated London News*, old Krakatoa's youthful offspring "Anak Krakatoa," at present a small island crater, growled, scowled, and menaced its neighbors once more. Alternately the new crater, comparatively small but promising, raised itself above the sea and sank beneath the waters.

What eventually will happen? Who knows? Those who believe the explosion of '83 was due merely to sea water leaking in on hot rock maintain that a similar event can not happen again, for the rock was all blown away. Others hold that the real cause was the explosion of superheated steam absorbed in and *all through* the molten magma in the earth's crust. A cubic mile of matter "popped" like popcorn, and may pop again. The people who live near Krakatoa wonder.

MINING THE SKY FOR SCIENTIFIC KNOWLEDGE

The Author

By W. J. HUMPHREYS, C.E., Ph.D.
Meteorological Physicist, United States Weather Bureau

NEARLY every one thinks of the rocket as something new under the sun. Well, it isn't, except in details of construction, for it has been in the air, so to speak, a long while, and written about for centuries. One could even collect a rocket library, for there are two or three dozen books on the subject, and a much greater number of papers, both ranging in dates from several hundred years ago to the very present.

The start of the rocket idea may not be recorded, but it is quite certain that any boy who happens to be bowled over by the kick of a musket might well have a rocket half invented by the time he gets up again. At any rate, the rebound of the old-fashioned blunderbuss doubtless suggested to many an observant victim the idea of turning the butt end of the thing toward the enemy for real effectiveness, or of standing it muzzle down that it might kick itself over the moon. Surely, at least, it was the action of reaction that led to the invention of the first crude rocket, for reaction is the very soul and essence of all rockets.

THUS far, everything was nice and promising, but right there Newton's law that reaction can not exceed action put a very finite limit to rocket attainments. So long as the gun weighs more than the bullet, it is the latter, and not the former, that goes the farthest—contrive as one may to obtain the opposite result. Furthermore, the going of either varies with the kind and quantity of the "powder" used.

And so it happened, owing to one handicap or another, that until very recently the only gun any one succeeded in making that would really kick itself heavenward was the familiar sky-rocket, a sort of 4th-of-July jazz toy for filling the air with booms and bangs and a lot of sparkles. But earnest efforts to attain more serious ends were not abandoned. Time and again a sort of rocket boat was invented, one that obviously would work, too, after a fashion, consisting of a pump of some sort amidships that sucked water in at the front of the vessel and drove it out at the rear. This method of propelling boats, however, does not seem to have come into commercial use, though it is conceivable that there might be places where, and circumstances under which, it would be just the thing.

Another contrivance that every one who thinks of rockets is sure to invent is a rocket torpedo; whether driven by the direct escape of compressed air or by some explosive is only a detail. And from this to the giant air torpedo that could carry the compliments of one enemy admiral to another by way of the clouds is only a seven-leagued stride of the imagination—a stride none too great to take, however, for visionary as it may seem, it nevertheless is within the range of the plodding steps of reality.

THE automobile, too, has been much in the thoughts of the rocket enthusiast who seemed to think, and with good reason, that a machine could be so constructed that by the time it had shot half its weight away the pilot gunner, riding the rest of it, might have won the race. The rocket automobile has not yet gotten beyond the dangerously experimental stage, but as at least a sporting machine it may be rather near ahead and coming fast. It has been proposed also to run the airplane on the rocket principle, in short to make it a giant rocket, so as to get there, wherever that may be, in no time. This, too, may be ahead of us, but somehow we are not looking for it to appear the first thing tomorrow morning. But, for all that, our fancy is caught by the wonderful stream-line shape such a device could be given all over, as long as its velocity was less than that of sound in the air.

The chief difficulty encountered in the operation of every sort of rocket is that of finding a substance that will blow out of its container with such terrific velocity as to produce a very great back pressure, and at the same time to be under control. Of course, there are other desirable features also, such as minimum weight of the device apart from its load of fuel, but all these, however valuable, obviously are secondary to the means for getting the thing to go at all. The solution of this fundamental problem of getting it to go, and to go well, has been the object of years of investigation, much theory and calculation and many experiments by different people, each after his own method, in different parts of the world.

In this country the most persistent and effective investigator of that problem is Professor Robert H. Goddard of Clark University. Just now he is at work on it harder than ever before, having both financial backing and the counsel and moral support of many eminent men of science. Of course, none of these conservative savants is envisaging an early Jules Verne trip to the moon in this super sky rocket—at least not for himself. He does envisage, however, the acquisition through it of much new information of both the solar and the terrestrial atmospheres, matters of very great scientific interest—answers to many questions which for decades we have been vainly asking. For every "good sport" this is game enough for the quest.

BUT who, then, are these good sports? That requires and deserves an explanation. The arts are developed, knowledge is attained, and civilization acquired when and only when there can be some surcease from toil, some rest from the daily grind of winning one's daily bread, some opportunity to stalk the game from mere choice and not from necessity, time to decorate one's clothing and ornament one's shelter, leisure to observe and experiment. But not all that have these opportunities use them. Most of us just eat and sleep and desire only better food and a softer bed. However, there always have been a few who were not wholly self-centered, who saw more in the universe than just themselves, and who still retained enough of the child's curiosity to try to find out something about that universe. These are the "good sports." They work when they don't have to. They have striven mightily in their efforts to discover the secrets of Nature, not with a bread-and-butter aim in view, but for the very love of the quest and under the urge of a compelling desire to know and to understand. Thus they gained knowledge, the knowledge that has given us our mastery, so far as we have it, over the world and all that is in it. To them chiefly we owe our civilization.

To all such as these explorers in the infinite realm of the unknown it would be useless to explain how any additional knowledge of our atmosphere and of the sun might be of practical use. To them, the mental satisfaction of knowing is of itself alone ample reward for almost any amount of labor expended in acquiring that knowledge, and especially so if it be new knowledge. They also know, though they don't bother about it, and we who do bother about it likewise know, that practical uses have been found for almost every scrap of information we possess of Nature and her ways, and therefore that it is virtually certain that abundant use will be found for substantially all additional information we yet may acquire of this kind. They may not know, and we may not know, immediately each discovery is made, nor be able even to surmise, what its applications will be, but everybody does know that use follows knowledge as surely as day follows night—follows, never precedes.

Dr. C. G. Abbot (at right), head of the Smithsonian Institution, with his invention, the silver disk pyrheliometer for measuring the intensity of the sun's radiation. Similar measurements made outside the atmosphere with a rocket would eliminate an uncertainty existing in some men's minds

BUT, despite all this philosophical calm, and assurance born of invariable past experience, it does seem reasonable to ask what sort of information could be obtained by means of a sky rocket of whatever supersize and power, and what possible use could be made of that information if we had it. Well, even that oldest of all sciences, astronomy, would be benefited, because, although as long as the astronomer confines his attention to the kinds of light the eye can perceive, red, yellow, green, and the rest of the spectrum colors, his troubles are not serious, or at least not insuperable, nevertheless when he pushes far beyond this limited region in either direction, whether into the ultra-violet, or exceedingly far out in the direction of the ultra-red, his apparatus fails wholly to function, and can not be made to function at the bottom of the atmosphere.

By far out in the long wavelength direction is meant the radio region of vast but indefinite extent. We know nothing of static from the sun or other celestial body, and could not, or at best, know but little, however full of such strays interplanetary space might happen to be, because the very high atmosphere is so good a conductor as to be opaque, or nearly so, to radio of every wavelength. Possibly we some day may be able to send a rocket, with a radio-recording attachment, beyond the conducting limits of our own envelope, and thus know definitely whether static of appreciable intensity is or is not knocking at our outer door. If it is, and it well may be, great will be our curiosity to know where it is from and what it means.

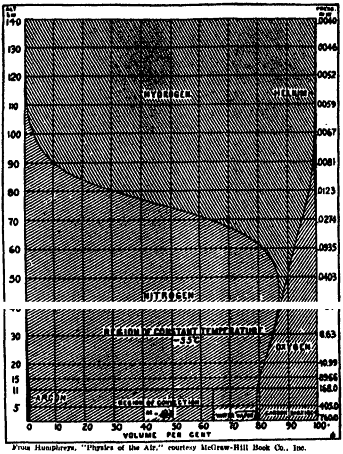
At the other end of the spectrum also, as just stated, we are helpless even in the highest balloons and on the tops of the loftiest mountains. Long before we have gotten half way down the spectrum from the limit of visibility the atmosphere has become opaque, and remains so to the very end. And it is through the photograms of this invisible region that Nature, in respect to the little things of the laboratory, has confided to us many of her innermost secrets. How we long for like confidences about the sun and the stars, and how fretfully impatient we become over the tantalizing fact that we can have them in abundance for the mere asking if only we will go a little way, merely to the confines of our own atmosphere, for them. Whether we ever get there ourselves or not, this much we can do: we can send a messenger in the form of a rocket equipped to receive these facts in code and return them safely to us.

We should like also to have direct measurements of the intensity of the total solar radiation just outside our atmosphere. Of course, this value can be computed very approximately from measurements made at the surface of the earth, but always there are residual uncertainties owing to the inconstancy of the atmosphere, and to the unknown value of the totally absorbed portion of the ultra-violet. It is to eliminate these uncertainties as far as possible that we need to have a few measurements of the solar constant quite outside any appreciable portion of this atmosphere, measurements that at present only the rocket promises to make possible.

THE rocket also can give us much information about the upper air, concerning which many more questions are asked than as yet can be answered. We know very accurately the composition of the atmosphere up to the greatest height reached by clouds (about seven miles in middle latitudes), or throughout the troposphere, the region in which there is constant stirring by vertical convection, hence the same proportions throughout of the several gases, except water vapor. At higher levels, however, where vertical convection is either absent or at most quite feeble, the exact composition of the air is unknown and the greater the height the greater this uncertainty. We know that there is lots more ozone in the upper atmosphere than there is anywhere below the tops of the highest mountains. We also believe from indirect observations that it is most concentrated about 25 miles above the surface. We should greatly like to know just where it does occur and why.

Auroras are nearly all stopped at approximately 60 miles above the earth. Again we ask why, and get no answer. What is the electrical state of the high atmosphere, how does it vary, and how is it maintained? Fair questions, all of them, but we can not answer them.

What is the temperature of the upper atmosphere? We know something about this. We know that, on the average, the air gets colder and colder with increase of height, up to around seven miles above sea level where its temperature is —67 degrees, Fahrenheit, or thereabouts. We know, too, that through at least the next seven miles the temperature is substantially constant with height. What it is much beyond that height, beyond the levels to which automatic-recording instruments have been carried by sounding balloons, is largely conjecture. It is true that the strange phenomenon of zones or rings of sound and silence around centers of terrific explosions has led to the conjecture that 25 to 40 miles above the earth the air is quite as warm as it is at the surface, if not even very much warmer. Many hold that the shooting stars, or meteors, strongly support the idea that the very high atmosphere is warm to hot. Indeed, it was a study of meteors that first led to that idea. Well, maybe so, but many a conservative scientist has his doubts about it and longs for direct observations such as, so far as only a rocket adequately equipped can supply.



From Humphreys, "Physics of the Air," courtesy McGraw-Hill Book Co., Inc.

Composition of the atmosphere at different levels. This is partly based on assumptions, because direct experimental observations are lacking above about 30 kilometers height

OBVIOUSLY the first thing to do in preparing for this investigation of the upper atmosphere is so to construct a rocket that it will attain very great heights, 25 miles at least, 100 miles, if possible. The next task will be so to equip the rocket as to secure the information desired. It would be only a useless stunt to send a rocket, however high, if it brought back no record of its journey. It therefore is a matter of business-like prudence and not a show of timidity to consider carefully before venturing on so difficult an enterprise whether a possible way to accomplish the desired results can be envisaged. This need not be the actual method followed but it is tremendously heartening to all concerned to know that results can be had, one way or another. To this end it will be interesting to outline a plan, however crude, whereby much knowledge of the upper atmosphere could be obtained by means of a rocket.

If the rocket is to reach great heights, say 50 miles above the earth, it seems unlikely that it could carry along unharmed any sort of delicate recording apparatus. It seems practically certain, too, that the unavoidable time-lag in response to the condition of the air passed through, of any device sturdy enough to withstand the stress upon it due to such a flight, would render every record so obtained wholly worthless. Presumably, therefore, we must try to obtain the desired data with exceedingly simple apparatus.

We possibly (and that is all the encouragement we need to go ahead) might obtain samples of the air under known conditions and at known heights and get our information from an examination of them in the laboratory. We must have these samples anyhow if we would know the composition of the air at great altitudes and its change with height, so while about that we might as well obtain them in such manner as to furnish the rest of the desired knowledge.

A possible method is as follows—a mere combination of well-known schemes that work. Let the rocket carry a highly exhausted thin-walled vessel of suitable size surrounded by a mixture of ice and water. This will maintain the vessel at a constant temperature, 32 degrees Fahrenheit or 0 degrees Centigrade, whatever the outside temperature may be. It has been tested under circumstances similar to those proposed here, and it worked. Let this vessel terminate at one end in a drawn-out and sealed-off tube wound at the proper place with a few turns of platinum wire that may be short-circuited to an ample but minute electric cell. Then provide that as the last of the propelling charge leaves the rocket (the time when the rocket has reached its greatest height and is moving slowest) the tip of the glass tube shall be broken, admitting air to the exhausted vessel, and at the same time the wire short-circuited so as to seal the tube again with its sample of air securely bottled up. All this, too, is an old trick that works.

We now have secured a sample of the upper air at a known temperature, not the temperature it had before capture, but that of the walls of the containing vessel, 0 degrees Centigrade, to which it necessarily came immediately on admission and before being sealed in. The little vessel containing this sample of air is eased back to earth by means of a suitable parachute, and further protected from injury on landing by a shock-absorbing device—all old and familiar tricks.

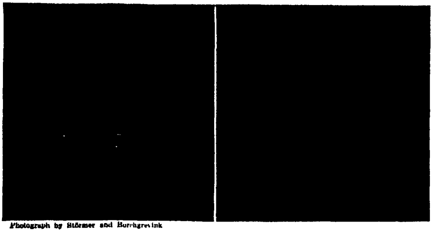
IN the laboratory the capture tube with its sample of upper air could be brought to the temperature it had when filled, 0 degrees Centigrade, and the pressure quite accurately determined at which this air just fills the tube at that temperature. This obviously would be the pressure of the atmosphere at the time and level of filling. After this, the sample could be analyzed and thus the composition of the free air at the level in question determined to any reasonable degree of accuracy.

Thus far well and good, but one important factor still is missing, namely, the height at which the sample was obtained. On very clear days the rocket might perhaps be followed by two theodolities some distance apart, the pointing of each noted at the time of filling —that is, when the rocket ceased to discharge, or when at its maximum altitude—and the actual height then calculated from these theodolite readings by simple triangulation, just as the heights of pilot balloons frequently have been determined.

Again, if the propelling discharge is luminous (it could be made so), the rocket could be followed and its height at the time of filling similarly determined by theodolities on cloudless dark nights.

Finally, a bright flash might be produced on the rocket at the time of sampling, and this flash photographed on suitable nights from two stations and the height of the flash determined from the positions of its images on the two photographs among the star images obtained at the same time. This is the simple "parallax method" used for finding the heights of the auroras.

We now have, let us suppose, the exact composition of the atmosphere and its pressure at numerous different known heights up to, say, 50 miles above sea level. From these data in turn we can readily compute the temperature distribution, for there is just one distribution of temperature that can give the observed pressures with the particular gases in question and at the specified heights.


Photograph by Störmer and Borrhgrevink

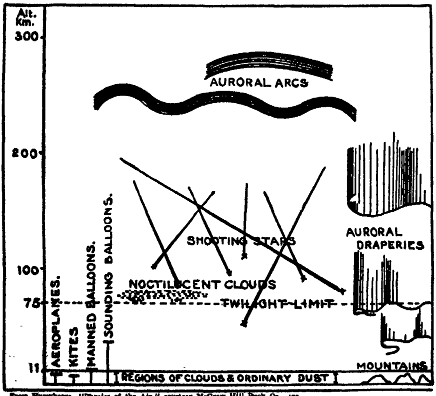
How the height of the aurora is determined photographically. (See text at left.) The same auroral curtain photographed at the same instant from opposite ends of a known baseline against the same background of stars (note Big Dipper)

CLEARLY, then, it is possible to obtain much information about the upper atmosphere by means of the rocket. This alone is enough to justify great effort in its development. Besides, as stated before, this knowledge once obtained is certain to have practical applications. Indeed we already see how it frequently might be used to great advantage in weather forecasting, for there is evidence that some of our least-expected general storms originate from conditions in the upper atmosphere, conditions of which only the rocket can inform us in time for our forecasts. Besides, this upper air may be the ideal medium in which to fly, especially on long trips. It is wholly free from the ice hazard, from all danger of lightning and from bumps of every kind. Also, piloting in it would be perfect, for there never is a cloud here to blot out the sun by day or hide the stars at night. But before we can fly in this region to best advantage we must know more about it than we know now.

In addition to its use in the important study of the upper air and its use also in several investigations of the sun and its radiation there is one practical need in sight—in fact, upon us—for the rocket in the lower atmosphere. That need is for it to take the place of the kite in getting the temperature, pressure, and humidity of the free air through the first two or three miles above the surface—information of great importance in weather forecasting. Kites can not be flown every day, and when they are flown it takes a good while to get them up and back again and, finally, they are being driven out of the air by the airplane. A kite wire is too great a hazard to the aviator to be tolerated where aviation is active. Of course, an airplane can be sent up for the sort of information that is gotten by kites, and some planes are used for that purpose, but it seems practically certain that the desired data could be obtained with a rocket (letting the recording instruments down slowly with a parachute) much quicker and at less cost than they can be with a plane. At any rate, this is one immediate practical application of the rocket well worth trying out fully and thoroughly.

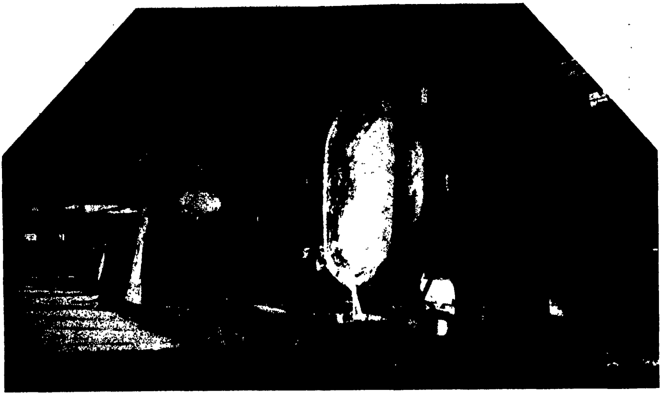
Now and again the forecaster is "up against it," as we say. The surface conditions may leave him wholly in doubt as to whether or not there will be local showers, perhaps, and yet the public insists on being told. For the moment this is discouraging, but there is buoyant hope in the fact that in most such cases the sounding of the air to the height of only two or three miles would change perplexing doubts to reasonable assurances. Nor would the occurrence of local showers alone be more certainly heralded in this way, but occasionally, disturbances even of great extent clearly indicated hours before there is available any sure surface evidence of their coming. We need the weather rocket for these practical purposes and must have it.

JULES VERNE'S *trip to the moon was* visionary, but mining the strata of the upper atmosphere for treasures of knowledge—knowledge that will have application in our daily affairs—is not visionary. This mining needs to be done. It can be done, and it will be done.



From Humphreys, "Physics of the Air," courtesy McGraw-Hill Book Co., inc.

Existing sources of meteorological information. Above the bottom eighth of the diagram our information at present must be obtained by indirect and comparatively unsatisfactory methods. Here the rocket would help immensely



Courtesy The A. M. Byers Company

Pure wrought iron of fixed quality produced by the ton. The "shotting" process is depicted above

MODERN "ALCHEMY" IN IRON AND STEEL

By F. D. McHUGH

VERY often we hear it said that man cannot today duplicate the quality of steel that made the smiths and forgers of Damascus famous throughout the medieval world. According to widely current belief no such steel as that in the blades of the Saracens can be made in this era of mass production. Why such an impression should persist it is difficult to understand. Some people seem to think that those Oriental iron masters had some secret which we, even with our greater advantages and experience, have not been able to find out for ourselves; or that to produce a Damascus steel requires artisans which we now lack. The fact is, however, that these opinions are fallacies born of ig-

Modern skill has not only equalled Damascus steel but has improved upon it. Scientific research within comparatively recent years has given man a mass of information which has widened the latitude with which he works with iron and the steels and alloys he derives from it; and has made this more truly an iron age than would have been considered possible only a few decades ago. The scientist, without whom ferrous metals would never have come fully into their own, has played with iron and steel, worked with them, made new and amazing alloys of them, has discovered new ways of working them, smelting them, refining, rolling, molding, and shaping them.

Most iron and steel manufacturers and makers of ferrous metal products today maintain large staffs of research scientists who study the idiosyncrasies of the metal from the time it is an oxide-red ore to the finished product. By them, new ferrous alloys are constantly being produced—alloys that fill some particular need or open the way to the manufacture of products previously impossible to make; or new schemes are devised for treating iron at various stages of its preparation.

THERE comes to mind offhand a notable instance of plant laboratory work of this nature. The A. O. Smith Corporation, of Milwaukee, which first commanded the attention of industry by building a huge automobile frame plant which is practically 100 percent automatic (see SCIENTIFIC AMERICAN, October, 1928), is now building a laboratory which will cost 1,500,000 dollars and eventually will have a staff of 1000 engineers and scientists. This staff will be built up by the addition of hundreds of specialists to the present force of hundreds—a force that already records among its achievements the development of the revolutionary pipe mills (of which more will be said later), the automatic frame plant, and many contributions to the scientific information and working principles of the industries that the company serves.

The problem of modifying the characteristics of iron by the addition of other metals to obtain greater strength, less weight, longer life, greater resistance to heat, greater cutting power—one or more of these qualities in a single ferrous metal—has been worked upon for over a century. Chromium, nickel, molybdenum, manganese, tungsten, and other metals have been used as alloying metals, but only the 20th Century [illegible] truly be called the era of alloy steels. Armor plate of nickel steel was one of the first successful alloys of this kind but now they run into the hundreds.

Of all the steel alloys in use, however, perhaps none is better known than stainless, or chromium steel. This silvery steel which first became known to the general public in the form of kitchen cutlery is now cutting the country's immense rust bills greatly, and it has been predicted that it may save industry a billion dollars annually. It may be said to be partly of British nativity and partly German. An English metallurgist, by the name of Brearly, while experimenting with gun lining metals, found that, by raising the chromium content, he could make the steel stainless. At about that time Dr. Benno Strauss, of Germany, was working on the same problem. He added nickel to the chromium steel and obtained a stainless steel, non-corroding, non-rusting, and of greater ductibility than the British steel, his proportions for the principal alloying metals being 18 percent of chromium and 8 percent nickel. Harry E. Sheldon, president of the Allegheny Steel Company—who was the first American manufacturer to make silicon steel and thus released our electrical industry from dependence upon Wales—was largely responsible for the manufacture of the first American stainless steel. Other manufacturers now make similar alloys.

THE chrome-nickel stainless steels, sometimes called "18 and 8" alloys because of the percentages of their principal alloying metals and to differentiate them from the stainless steels and rust-resisting irons having no nickel, now find a wide use in industry where resistance to fruit, vegetable, and meat acids is desired. Dairy equipment, chemical plant apparatus, and kitchen utensils, tables, and so forth, for large hotels and restaurants now account for much of the production of the "18 and 8" steels. The Model A Ford uses Allegheny metal for its bright parts and this same metal is being used in great vertical strips for trim on the exterior of the 85-story Empire State Building in New York City. A similar alloy, Nirosta, made at the Central Alloy plant of the Republic Steel Corporation was used on the beautiful tower of the Chrysler Building.

Another alloy with which many are more or less familiar, since it has been used for several years, is Permalloy. This is a nickel steel which was developed after the discovery, in the laboratories of the American Telephone and Telegraph Company and the Western Electric Company, that remarkable magnetic properties were possessed by nickel iron in which the proportion of nickel exceeded 30 percent. Best results were obtained when the percentage of nickel was as high as 80. This metal, called Permalloy, has since been largely used for the loading of telephone and telegraph cables, and in the construction of instrument and audio-frequency transformers, relays, and measuring instruments. Recently the British laboratories of the International Telephone and Telegraph Company developed a new alloy in this series which is to be called "Permalloy C" and which will replace the original Permalloy A, and will largely replace a second member, Permalloy B. Permalloy C is the softest magnetic material available.

Cobalt steel is another new alloy with remarkable magnetic properties. Developed in the laboratories of ie Westinghouse Electric and Mar ufacturing Company, this alloy can be given a powerful magnetic "charge" made a permanent net. Onc portant has beer drive from an electr motor that is totally enclosed to exclude dust, fumes, moisture, et cetera, to the external shaft whicl has no physical connecti with the motor itself. The magnetic lines of force of cobalt steel on the motor shaft are "enmeshed," like the teeth of a gear, with the magnetic lines of force of cobalt steel on the external shaft, thus providing a positive, cushioned drive.

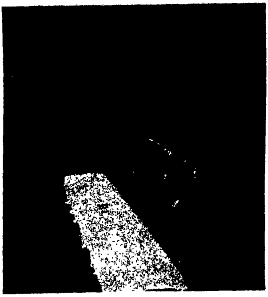
The Westinghouse laboratories have also developed an alloy called Konel which is credited with being much stronger and tougher than other metals at high temperatures and can, therefore, be used extensively in the moving parts of internal combustion engines and in other extremely hot places. Its constituents are cobalt, nickel, and ferrotitanium. It was originally developed for use in the manufacture of radio tube filaments, and in that use is said to result in the saving of 250,000 dollars monthly at present. Konel filaments last 10 times as long as other filaments.

Other alloys or kinds of steel or iron are perhaps as important in their own particular applications as those already mentioned, but the list is entirely too long to be reviewed here. We might mention Promal, however, for it may in time be adapted to a wide variety of uses. Originally developed by the Link-Belt Company as a metal to be cast into drive chains, it is not an alloy but a specially treated iron. Experimentation with cast chain metals, begun four years ago, led to the discovery of a new method of processing malleable iron which so altered its characteristics as to make of it a distinctly new metal. Compared with malleable iron, Promal has a much higher yield point, an ultimate average strength about 22 percent higher, a lower average elongation, and a 40 to 45 percent higher Brinell hardness. It is claimed that the new metal therefore has surprising durability.

Probably the outstanding metallurgical development of recent years, for certain special applications, is that of nitriding. This process, preferable to case-hardening—especially for Diesel engines where surface toughness, resistance to wear, and freedom from dis-

Courtesy The A. M. Byers Company

The "little red ball" being taken from the puddler's furnace. *Above:* The "big red ball," weighing ten times as much, as produced by the Byers New Process



tortion are required—resulted from the studies of Dr. Adolf Fry of the Krupp works in Germany. Several French investigators and Dr. V. O. Homerberg, of the Massachusetts Institute of Technology have also carried out extensive researches in the process.

In nitriding, any one of a series of steel alloys, known generally to the trade as Nitralloy, is heated to temperatures varying between 900 and 1000 degrees, Fahrenheit, in an atmosphere of anhydrous ammonia for from two to 90 hours depending upon the depth of the case required. The low temperature used prevents the core from being affected during the process. After its completion, no further machining may be done on the nitrided material since it is extremely hard—its Brinell hardness being 900 to 1100 contrasted to 650 for case-hardening; hence proper annealing and finish-machining must be done previously. The treated metal has, besides surface hardness and resistance to wear, a good resistance to scoring and abrasion, resistance to corrosion—it is therefore a stainless steel—no distortion in hardening, and hardness maintained up to high temperatures. Furthermore the case has no tendency to peel off, as the transition from core to surface takes place gradually.

THE metals of the Nitralloy series used in the nitriding process all possess a definite amount of aluminum because of the hardness this metal imparts to the surface of the steel when subjected to the action of the nitrogen in the ammonia and because of the desirable physical properties it induces in the core. The other constituents of the alloy vary in proportion according to the strength of core desired—that is, according to the specific application of the article being produced.

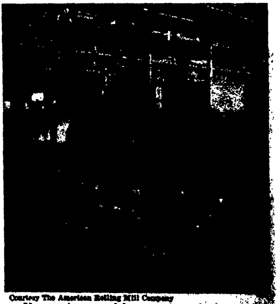
For many centuries man has made and used quantities of wrought iron. It is notable for its fine working qualities, its toughness, and its resistance to rust. One of the oldest and most useful of metals, it was known and valued by the ancient civilizations of India and Egypt. As recently as 70 years ago it was a very much larger industry than that of steel but the invention of the Bessemer process in 1856 caused wrought iron to be eclipsed by its cheaper but harder and stronger cousin, steel, even for uses in which it is unquestionably superior. Up until the 14th Century wrought iron was made in a very pure form in the Catalan forge, but for the past one hundred years it has been made by the laborious and expensive hand-puddling method.

Scientists long studied the problem of developing a commercially feasible and cheaper mechanical process for quantity-production of wrought iron but their efforts were attended with failure until Dr. James Aston developed, something over two years ago, a successful process of mechanical puddling. Wrought iron made by this process promises to take once more its rightful place as one of the world's most useful metals. The A. M. Byers Company will see to that, for they have just completed a new 10,000,000-dollar plant at Ambridge, Pennsylvania, with an initial capacity of 600 tons of wrought iron daily, to supplement the 200 tons daily they have been producing for over two years at their Pilot plant.

WROUGHT iron is a malleable iron shot through with slag particles, slag being essentially a ferrous silicate high in iron oxide content. In the hand-puddling process, it is made by melting together on the hearth of a reverberatory furnace certain proportions of pig iron and iron ore. Stirring of the molten mass, or puddling, by workmen, causes proper mixture of the iron and the slag, eliminates undesirable gases and elements, and results in the formation of a spongy ball of practically pure iron of a higher melting point than that of the original pig iron. This sponge, weighing only about 250 pounds, is squeezed in a press and then rolled into billets.

In the Byers New Process, as Dr. Aston's development is commercially known, Bessemer-grade pig iron is melted in a 12-foot diameter cupola of the standard steelworks type. The slag to be used is melted independently. The sources of supply of the slag are: puddling-furnace tap cinder, heating furnace cinder, roll scale, iron ore, and sand. The composition is maintained in close conformity to the slag found in good wrought iron.

The "shotting" operation—that which replaces puddling—is carried out in a set of unlined, stationary cups, or thimbles, on standards along the pouring platform. The average "heat" of blown metal is 5000 pounds and since this is usually formed into



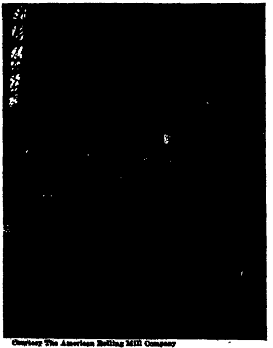
Courtesy The American Rolling Mill Company

Upper: A great slab starts through the continuous mills; in 2[illegible] seconds is a 200-foot sheet of red metal (*middle*) running at comparatively high speed over the rolls and is coiled auto-two spongy balls, two cups are used. Into one of the cups there is poured from the melting furnace enough melted slag to half fill it; and about one-half the ladle of blown metal is poured, in turn, into this slag. During the pouring of the iron, the slag boils vigorously. Cold, granulated slag is added to the mixture from time to time, largely to quiet the action and prevent its boiling over, as one adds cold water to boiling coffee.

As the pouring is completed, the boil subsides and the slag level goes down. A crane then lifts the cup and pours the excess slag into the adjoining empty vessel which is ready to receive the other 2500 pounds of the ladle metal. In the treated cup, there is now a solidified, spongy mass of metal shot through with liquid slag. This red-ball, equal in all respects to the product of hand puddling, but weighing 2500 pounds compared to 250 pounds for the ball produced by the slower, more expensive, hand-puddling process, is dumped upon a carriage and taken to a press which compresses it into a bloom. It is understood that in the new Byers plant the balls will weigh about two tons each.

WHILE a review of the many new processes for working iron or steel would fill many pages, a few outstanding ones, not necessarily the most important, suffice to indicate the progress that is being made continually.

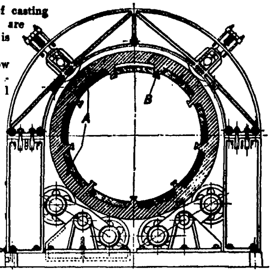
Charles Pack, a consulting engineer of New York City, reported some time ago that a machine which forms articles from cast iron continuously in the same mold, is in use in Germany. No details of the machine were divulged but if it is all it is claimed to be, it represents a distinct and industrially important advance over the old method of casting iron in sand molds which are broken up after one casting is made.



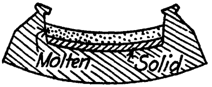
Courtesy The American Rolling Mill Company

continuous sheet process, rolls are accurately adjusted for proper gage by machines

The process of casting hollow objects in rapidly spinning n chines—that is, the centrifu l casting process—is over a hundred years old. Even the centrifugal process of casting iron pipe dates from before 1850 for the pipe-making method first used by Shanks in London was described in SCIENTIFIC AMERICAN in the issue of December 1, 1849. However, the long-sought process of casting steel gots centrifugally elu steel manufacturers u Leon Cammen, a New York consulting engineer, perfected what is known as the Cammen Process.



Courtesy Leon Cammen



Transverse section through the centrifugal bar-casting machine, the rapidly rotating "barrel churn." *At left:* The freezing of cast bars

As an ordinary steel ingot cools, the steel cools so rapidly that a crust is formed over the molten metal within. As this crust thickens, it contracts. This contraction sets up strains within the ingot and the resulting weakness is called "ingotism." To remedy this, the ingot must be put through a soaking pit and then a blooming mill. The Cammen Process eliminates these last two operations and produces ingots ready for bar or sheet mills. Furthermore, centrifugally cast ingots do not have to be trimmed, so that an additional saving is effected. Thus it is said that an investment of 750,000 dollars for the centrifugal casting equipment is substituted for one of 2,500,000 dollars for necessary equipment for the old process.

Essentially the Cammen centrifugal casting machine consists of a huge "barrel churn" cylinder with the inner surface of its periphery hollowed out and divided into sections to receive the liquid metal. It is supported and rotated by wheels like a huge roller bearing. As it is rotated at several hundred revolutions per minute, molten steel is poured, at a predetermined rate, into the inner rim where it is caught in the whirl, is thrown outward by centrifugal force hard against the rim, spreads to the sections, and begins to cool. It cools so rapidly, first as a very thin sheet and then as consecutive thin sheets, that the final ingot does not have "ingotism." This manner of cooling also "presses" out by centrifugal force the undesirable gases which would be imprisoned within the hard shell of the ordinary ingot. Complete solidification takes place in from 30 to 45 seconds, contrasted to the 15 to 30 minutes for ingots made according to usual practice. It is understood that the Central Alloy plant of the Republic Steel Corporation holds a license for the use of the Cammen Process.

IN rolling sheet iron and steel, the ordinary process has been a see-saw method of passing the metal back and forth through various sets of rolls. The future sheet has to be personally conducted—that is, an operator has to stand at the controls and reverse the direction of the moving metal after it passes each set of rolls, so that it passes through the rolls of the next smaller size, or back through the same rolls after they have been readjusted to a smaller clearance. When sheets become too long, the units are folded and rolled again to proper thickness. The sheets are then separated, squared to size, and annealed.

The American Rolling Mill Company, however, has perfected equipment for rolling a continuous sheet of metal. Prior to the time this company's engineers began their investigations in 1914, no successful way had been discovered to roll thin, wide iron and steel sheets by a continuous mechanical process. Two years ago their new continuous sheet mill began operations and greatly increased their production at lower cost.

The Armco engineers found that they had a two-fold problem. First, they had to design production and conveying machinery to carry hot ingots from the

Courtesy A. O. Smith Corpor

Striking test of Smithwelded pipe. A section is rolled until it is a flat curl as shown

blooming mill through to the finished sheets without a break in the long line of operation. Secondly, the characteristics of iron in its heated state when passing through the rolls of this continuous process, were studied. This latter question baffled them and it had to be turned over to the metallurgists. In fact, so many different details had to be worked out that it can be truthfully said that Armco pioneered in developing this continuous rolling process.

TO describe it in detail is unnecessary; it is just what its name implies. Beginning as an 11,000-pound ingot, the metal travels in a straight line for some 800 feet and is delivered at the end of the line in a continuous sheet, at the rate of more than a ton a minute. So rapid is the speed of the pieces of hot metal as they pass down the line of operation that one must move rapidly to keep pace with them. The approximate daily capacity of a continuous mill unit is 1400 tons, requiring 1700 tons of ingots.

The Sharon Steel Hoop Company, Sharon, Pennsylvania, have a continuous process for making steel strip that is so fast that one end of the strip is in the shipping room before the other end is out of the furnace. Of the many new methods and improved equipment incorporated in this mill, we have space to mention but one: the novel method of communication.

To facilitate high speed production, a modified public address system, comprising a microphone and loud speaker, has been installed. By means of this equipment, the men on the rolling floor deliver instructions regarding operations and speed changes to an operator in a control "pulpit." This pulpit operator is therefore in constant, audible touch with the work he controls and which he can see through the glass sides of his elevated pulpit.

Casting about for new industrial fields to conquer, the A. O. Smith Corporation, mentioned earlier in this article, decided to make pipe. With its customary initiative and directness, the company tackled the problem as a newcomer, but as a newcomer wise in scientific research and free from the trammels of tradition. Why others had always made pipe in a standard length of 20 feet they could not discover; so they proceeded to upset that tradition by planning plants to make pipe *in uniform lengths of 30, 40, and 60 feet.* This apparently negligible change makes possible a great saving since it decreases by one half or two thirds the number of field joints necessary to be made. Two plants were built in short order by this company, the first with a daily capacity of eight miles of oil and gas pipe, and the second with a daily capacity of 20 miles of pipe in diameters from 12 to 26 inches.

The steel plate from which the pipe is made is received within small tolerances of the size required to make the desired diameters and lengths. Pickled, cleaned, and dried, the metal then has its edges scarfed for welding. It then goes through various press operations, is formed into tubular sections, and the longitudinal seam is electric-arc welded. The pipe is then sized to make it exactly round; its ends are squared off; and it is hydrostatically tested at double the working pressure or higher. Washing, drying, and painting complete it. The significant fact about these operations is that they *are all automatic.*

Plant scientists and engineers are working on or have perfected new methods of refining steel, of determining the presence of harmful impurities in steel, and of de-oxidizing open hearth steel whereby cleaner metal is obtained than that produced at the present time. The story of the work on the last named process is an excellent illustration of the laboratory method of working out a problem and ultimately applying it to practical operation in steel plants, but lack of space makes recitation of it here impossible.

SLAGS, which have always been, and probably always will be, one of the controlling factors in the production of good steel, have been a subject of special scrutiny by the research engineers. Experiments in the laboratory and in the plants indicate that certain properties of slag which have to date been little studied, have a decided effect upon the speed of working of the furnace and the ultimate reliability of the product. Further study of slags will, it is believed, result in great benefit to the industry.

In this review, we have not attempted to cover the entire field of metallurgical and manufacturing achievements in the iron and steel industry; there are many other advances perhaps equally as important as those mentioned. Rather have we outlined a few that seem to symbolize the initiative and scientific foresight of iron and steel men. Their research scientists and plant designers are true modern alchemists who transmute the base metal, iron, into noble metals of strength and beauty and universal usefulness.

Made airtight, the curled section shown above is subjected to high pressure. It slowly uncurls and finally ruptures at five times normal working pressure

PRESERVING NEWSPAPER FILES

By **R. P. WALTON, Ph. D.**
Formerly of New York Public Library

ALL records published on modern, wood pulp papers are faced with the probability of destruction within a spectacularly short time. This is particularly true of newspapers printed on paper made of ground wood. In the January 1929 issue of the SCIENTIFIC AMERICAN, the ravaged condition of recent newspaper volumes was illustrated. According to these evidences, newspaper accounts of the World War, which were printed on ground wood paper, will soon have crumbled and disappeared, while newspapers of the Colonial period, printed on paper made from rags, will still faithfully carry their stories of early American history.

Custodians and librarians have been faced with this responsibility of perpetuating records which have been printed on highly transitory and impermanent paper stock. Accordingly, some rather elaborate methods have been developed in the efforts to rescue these accounts from rapid extinction.

Princeton University, at a cost of about 20,000 dollars, has prepared clippings of the World War and has used a special process in attempting their preservation. The 81,242 pages, which make up the scrap books, were treated with a specially prepared paste which acts as a preservative. After being mounted, the loose sheets were placed between blotters and each submitted to a three-ton pressure. This pressure was maintained for five weeks with each sheet, a careful watch being kept from day to day to see that the pressure was uniform. The result was that all the moisture was taken from the paste, leaving the columns of printed matter a permanent part of the page.

After considerable experimentation, the New York Public Library has developed its own method. Essentially the process consists in covering both sides of each separate sheet with Japanese tissue. A pure wheat flour paste serves as the adhesive. To begin the process, a large glass plate is brushed with the paste. A sheet of tissue is then laid on the pasted glass and is also brushed with the paste on the upper side. The paper sheet is thereupon laid on the tissue, and this is covered in turn with another sheet of tissue, each being brushed with paste as soon as they are laid down. After the newspaper sheets are thus mounted between layers of Japanese tissue they are hung up to dry, then pressed and run through a gas heated mangle with steel rollers in order to smooth out all irregularities. The sheets are finally reassembled, sewed, and bound.

THE tissue is so thin that the size of the volume is not unduly increased. By actual measurement, an ordinary sheet of Japanese tissue has a thickness of 0.0017 inches, whereas ordinary newspaper has a thickness of about 0.0033 to 0.0040 inches. The strength of the paper is considerably increased by the additional backing and this is an item of prime importance when newspapers and books are subjected to frequent use. Recent tests by the United States Bureau of Standards demonstrate that the strength is increased from three to four times by use of the tissue. The weight of the paper is increased about 50 percent; transparency is lessened, but not enough to make reading difficult.

***To Right:* Covering the perishable newspapers printed on wood pulp paper with the Japanese tissue. *Below:* Rolling or calendering the sheets on a gas-heated mangle before assembling**

The protective value of the treatment has been tested approximately by exposing treated and untreated sheets to direct sun rays for periods of 100 to 150 hours. Unprotected paper turned brittle and yellow very rapidly; the covered paper was only slightly affected and remained encouragingly flexible. The United States Bureau of Standards has recently made similar tests, in which the samples were heated in an oven at 100 degrees Centigrade, through which a stream of air was rapidly passed. After this process of accelerated aging, unprotected paper was found to have lost 20 percent of its strength, whereas, protected paper was hardly affected. Coloration, following this heating treatment, was much more pronounced in the case of unprotected paper. By the same series of tests, Japanese tissue was found to behave as an unusually high grade of paper. Copper number and alpha-cellulose content, the best known indexes of chemical change, were not substantially affected by the heat exposure.

The protective covering of Japanese tissue is now regularly applied to several important newspapers as soon as they are published, the expense being partly borne by the newspaper company. The New York *World* was the first to adopt this co-operative arrangement so that their protected file is now 13 years old. From all present evidences these files will still be in good shape after many decades of heavy service. Most encouraging is the finding that newspapers thus covered with tissue can be rebound after the covers are worn.

AN ACTOR TURNS INVENTOR

A Safety Oven Shelf Spelled Financial Success After a Lifetime on the Stage

By MILTON WRIGHT

INVENTORS are found in all walks of life; there is scarcely a calling you can think of in which men have not worked out new ideas, gone to the Patent Office with them, and eventually added to the comfort or efficiency of the rest of us and perhaps made fortunes for themselves. Nevertheless, when a well known stage and motion picture director bobs up as the inventor of a successful device for housewives to use in the kitchen, the circumstances are so unusual as to warrant looking into. We got hold of this inventor—William Parke—and asked him to tell us about it.

"The story of the safety oven shelf," he said, "is not very different from the story of pilot light. It was a fight for years before it became standard equipment on gas ranges. The same thing was true of the enameled metal stove, oven heat control, and insulated ovens. Each of them was a distinct step forward in kitchen efficiency, but the stove companies as a whole are conservative and few new inventions are put over at once."

"Yes," we interrupted, "but how is it that an actor and stage manager invented a successful piece of equipment for a kitchen stove? Such people are not supposed to have much home life, are they?"

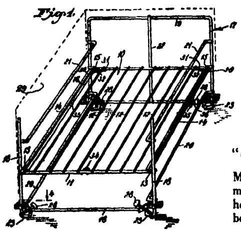
"IT was sort of forced upon me," he laughed.

"Was that the first invention that you ever made?"

"It was the first one I patented. A stage manager, you know, has to be something of an inventor, as well as a lot of other things.

"Any mechanical training I had, however, began when I started to work at the age of 14, running stamping machines in a tin factory. My job was to feed little round disks into a press. In such work it was necessary for the operator to put his fingers under the punch, and every once in a while some boy would get a finger cut off. Now I didn't want anything like that to happen to me, so I worked out a little trough to feed the disks through. It was adopted. Perhaps if I had thought to take out a patent I might have made money on it."

As a factory hand young Parke continued until he was 22 years old, when, having histrionic ambitions, he obtained a job as an actor in a Philadelphia theater. Doing small parts at first, he became assistant stage manager, and then stage director at another theater. As an actor and stage manager he went west, returning east in 1900 to become advance stage manager for E. H. Sothern. He continued in the same capacity when Sothern and Julia Marlowe toured together. He acted as stage manager for Arnold Daly for a season, and appeared in vaudeville with Daly and Helen Ware. He was stage manager for Richard Mansfield in 1907, when Peer Gynt was being produced.



Oval: **William Parke, the inventor.** *Drawing:* **This safety oven shelf can be advanced or retracted for inspection or turning, enabling baking or broiling operations to be carried on safely and expeditiously**

In 1912, Parke began something which the theatrical profession holds is far more important than all the kitchen devices he could possibly invent. He was the pioneer of the Little Theater movement in this country. He inaugurated the William Parke Stock Company, of which Walter Pritchard Eaton said, "It is more important to the city of Pittsfield than the public library. If the public will support it, he will be producing in Pittsfield new plays and having the managers up from New York to see them. His company could go to other cities. Such a stock company can be the solution to the small town theater problem."

But Pittsfield was not a big enough city for the experiment, and in time Parke found himself 5000 dollars in debt. He closed the theater and returned to New York with 60 dollars in his pocket. He took a job as stage director for the original Potash and Perlmutter company, and within a year had paid back every cent of his indebtedness to his Pittsfield creditors, who never had expected to see their money again.

But the movies were calling, and, although Parke could not foresee it, he was now headed towards his kitchen invention. He directed pictures first for the Thannhauser studio in the east, next for Pathé, and then he went to California to direct for the Goldman studio. He directed a picture for Pauline Frederick, but it was so cut by a picture editor that Parke insisted upon his release. Then he made two independent pictures, but after that nothing was open for him in pictures. For two whole years nothing to do.

"OUR housekeeper offered of her own accord to work elsewhere," said Mr. Parke, in telling how he came to make his invention. "Mrs. Parke did our housework herself. Perhaps if she had been trained to it instead of having been on the stage she might have been a little more expert, but then we never would have had the invention. One day when she was taking a roast out of the oven to baste it, the oven rack tilted down and the roast slipped out and her hand was badly burned.

"If that happened to her, I reasoned, it probably happened to many other women. There ought to be some way of pulling out an oven rack without danger. I worked out a rack in my mind that could be pulled out and remain horizontal. Instead of having it slide on a thin shelf or runner on the oven wall, I provided a rod attached to the inside of the oven. A projection on the shelf caught and held fast when the rack was about two thirds out.

"Having figured it out, I went to a wood-working place and had a model made. Then I applied for a patent. Then I took the wood model to a machine shop, bought a stove, and had the rack made and installed. I had no means of knowing, you see, whether or not it actually would work in the heat of the oven. One day after dinner I turned the heat on full, and every fifteen minutes for three hours I opened the door and pulled out the rack. It worked perfectly. I knew I had something.

"My friends and neighbors thought it was great, so I came on to New York to start it going. One of my friends suggested that a company be formed to raise money. I did this and formed a corporation with a capitalization of 100,000 dollars. About 40,000 dollars' worth of stock was sold, mostly to friends in the theatrical profession.

"In New York I did two things: took a machine shop to perfect the invention and got in touch with the Consolidated Gas Company. The gas company put it in its laboratory to test it out and then began to recommend it to stove manufacturers. Meantime I worked out a simpler and less expensive idea and applied again for a patent. Then I saw still another means for simplifying it and once again applied for a patent. This time the gas company told me to stop where I was—that I had it fundamentally right. I went ahead, however, and devised a special handle and got a patent on that.

"THE next step was to get indorsements that would help put the invented article over. This I did by taking it up with the *Good Housekeeping* Institute, the *Herald-Tribune* Institute and *Modern Priscilla*. They tested and approved it and I was now ready for the market."

"And from then on it has just kept growing like a snowball?" we asked at this point.

"Not by any means," he replied. "The struggle was just beginning. After all, you must remember, I was just an outsider trying to break into the stove business, even if I did have the biggest gas company in the country lending me its moral support. I went to other gas companies—in Brooklyn, New Jersey, Philadelphia, Pittsburgh. They all said it was a good thing, but that if they were to sell it, it would make all the other stoves they had sold and were still selling look ridiculous. They urged that it be adopted by the stove companies."

"And then the stove manufacturers took it up?"

"Not right away. It was exhibited at the American Gas Association convention in Atlantic City in 1926, where the stove manufacturers had a chance to see it. The executives of the stove companies were discouraging, but the stove engineers all agreed that the idea was good. They predicted that when one or two of the companies should take it up, the women of the country would demand it in all stoves, and it now looks as if they were correct.

"Presently a new phase developed in the situation. Stove men began to agree on the merit of the rack, but asked why they should pay me 25 cents—the royalty I asked—when they could make a rack of their own devising. I had expected this and was ready for it. At every step of the way I had obtained patent protection. Some of the companies tried in vain to work out something to take the place of mine. One well known stove manufacturer did succeed in making an invention, equipped stoves with it and offered it to the Consolidated Gas Company. The Consolidated pronounced it useless, and said it would take the stoves if they were equipped with *my* racks.

"The turning point had come. The gas companies, you know, are the big stove distributors of the country. It was no great while before I signed my first contract with a prominent stove manufacturer. He wanted an exclusive contract, but that of course was unthinkable. After that it was not long before I was negotiating with the largest company in the world which makes the oven racks for most of the stove companies.

"Meantime, there were the stoves which were already in use to be considered, for the stove companies were interested only in making new stoves. I devised and patented a frame of rods which could be set up in any oven for the rack to slide on. This business I have kept in my own hands, thereby getting a double hold on the business; if a woman buys a new stove with the safety oven rack, I profit by means of a royalty; if she gets only the frame and rack to make her old oven safe, I make a manufacturing profit."

The movable shelf is limited in motion but safely carries the roast out for various culinary operations

"Just one more question, Mr. Parke. Would you say that the success of the safety oven range is due to the fact that it meets a real need?"

"That is largely it, of course, but the need is really the foundation of a commercially successful invention, rather than its whole explanation. Naturally you must have a practical invention to start with, but, as I see it, two other things are necessary. First, you must see that you are protected fully, so that no one can take from you the profits which flow from your idea. Second, you must keep plugging away at it month after month and year after year in spite of every discouragement that will be thrown in your way, confident that if your idea is right, success will come if only you work hard enough and long enough."

IT might be interesting to know what the potential field is for a household device of this kind. Of course we do not mean that the rack described will be applied to every oven in the United States—this would be a Utopian dream. However, food for the families in the United States is largely prepared by gas, which has routed most of the coal and wood ranges to the scrap heap, except in rural locations. It has been found by accurate survey that there are not less than 13,000,000 gas ranges as against 8,300,000 of the coal and wood variety. Oil ranges are much used in the country, 6,000,000 being in daily operation. Evidently electricity has not come into its own yet for we find only 600,000 reliably reported as in use. It is by such figures, however, that the inventor must be guided in his efforts to introduce his product to the general public.

PRACTICAL X-RAY CRYSTAL ANALYSIS IN ENGINEERING[1]

By V. E. PULLIN
Director of Radiological Research, Research Department, Woolwich, England

IT was not for many years after the discovery of X rays that their nature was understood and they were identified with ordinary light. This development came about as a result of a brilliant piece of mathematical analysis by Professor von Laue in 1912. Von Laue's prediction was that if X rays had the same nature as light, but of infinitely shorter wavelength, their diffraction should be possible if a suitable—that is, fine enough—diffraction grating could be found. He suggested that a crystal, because of the regularity of its structure and the distance apart of its constituent atoms, would function perfectly in this respect as a three-dimensional transmission grating. Friedrich and Knipping carried out experimental work on these lines with conspicuous success, and the identity of X rays as an electro-magnetic phenomenon was put beyond all doubt.

This discovery, quite apart from its theoretical and historic interest, was destined to add enormously to the practical value of X rays in quite a new and hitherto unsuspected field of work.

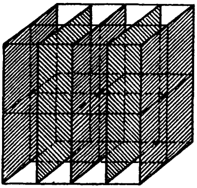
THE fine structure of materials must obviously exert a very great influence on their physical properties. By fine structure is meant something very much smaller than anything capable of detection by a microscope, and for this reason something which, prior to von Laue's discovery in 1912, had proved impossible of direct investigation. In this connection there are two highly important facts which render X-ray crystal analysis of paramount importance to engineers. First of all, metals and most engineering materials are crystalline, and, secondly, the working of metals, either by tools or heat, always tends to alter or modify the crystal structure. It is the business of X rays in this connection to provide us with pictures or diagrams from which we may, if we have the necessary knowledge, deduce the manner in which individual atoms are normally arranged, and how they are modified by mechanical or heat treatment or by alloying with other elements. The next operation is the interpretation of the X-ray story in terms of mechanical properties.

The physicist who concerns himself with X-ray analysis has really progressed quite a long way in the art of obtaining and interpreting X-ray spectra, but he is very often in considerable difficulty when he seeks to apply his results in practice. For this reason much closer collaboration is desirable between the X-ray worker and the engineer. X-ray crystal analysis is a very highly technical subject, and it is idle to suppose that it can ever reach a stage where it may be used as readily by the engineer, as, for example, the microscope. Nevertheless, a working knowledge of the subject and its limitations can be, and should be, acquired by every engineer. It is fundamental to his subject.

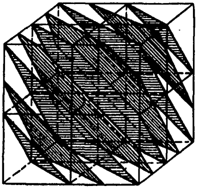
It is the purpose of this article to explain in general terms what crystal analysis depends upon and how it is done; and also to show from some typical spectra how their interpretation is important in general engineering practice. No attempt will be made to discuss the many applications of the subject in other spheres of activity.

In the first place, it may be said that any crystalline material is suitable for investigation by X-ray spectrum analysis—most substances and all metals are therefore suitable. The next point for consideration is the character of a crystal and why it is that so much information may be derived from its analysis.

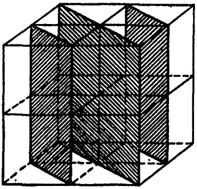
A crystalline substance is one characterized by the regular arrangement of its structural units. According to the material of the crystal, these units, which may be atoms or groups of atoms, are arranged in a perfectly definite pattern which is repeated over and over again in three directions. Crystals grow, and by their growth is meant that this identical pattern of units reproduces itself again and again along the three axes of the structure. A crystal, then, is



100 PLANES
FIG. 1



111 PLANES
FIG. 2



110 PLANES
"THE ENGINEER"
FIG. 3

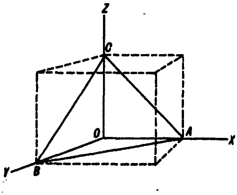


FIG. 4

Figures 1 to 4: A little study of crystallography simply a regular arrangement of structural units. If we could see inside and through it, which is impossible, we should find a beautiful and symmetrical honeycomb structure or lattice, presenting exactly the same appearance from any point on the lattice.

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[1] Reprinted by permission from *The Engineer* (London)

There are many different kinds of crystals, and they have been classified according to their external features into some 32 classes, of which only three types are of immediate importance to the engineer. They are called (1) face-centered cubic crystals, (2) body-centered cubic crystals, and (3) hexagonal crystals. To the first group belong metals which are ductile, such as copper, aluminum, silver, gold, lead, nickel, and that variety of iron known as the γ (gamma) type. To the second group belong α (alpha) iron and the brittle metals, such as molybdenum, tungsten, chromium, and so on; and to the third group belong zinc, osmium, and some few others.

A CRYSTAL lattice of the first type is cubic, having an atom at each corner—which, of course, it shares with adjacent cubes—and one in the center of each face; each crystal unit cell will therefore contain four atoms. The second type has an atom at each corner and one in the center of the cube; each crystal unit cell will therefore contain two atoms. The third consists of two simple hexagonal lattices, combined so that each cell contains two atoms. The atoms in a crystal unit cell are separated from each other by about an X-ray wavelength; in other words, the length of any side of such a cell is of the order of one Ångström unit (an Ångström unit is one hundred millionth of a centimeter).

Reference to Figures 1, 2, and 3 will show that we may draw various series of planes through such lattices as I have described. Crystallographers for convenience name these planes with reference to the three axes of the cube; for example, in Figure 4, OX, OY, and OZ are the three axes of the cube, and the planes in our illustrations are named in so far as they cut any of these axes. Thus, the plane A, B, C—Figure 4—cuts each axis once; therefore it is called the (111) plane. The planes shown in Figure 1 cut the OX axis only, and are therefore called (100) planes. The planes in Figure 3 cut the OX and the OY axes and are called (110) planes, and so on.

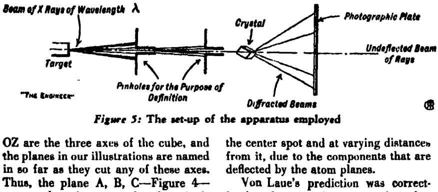

Figure 5: The set-up of the apparatus employed

For the purpose we have in view—that is, that the engineer shall understand something of this field of work and the nature of the information yielded by this new method of investigation—it is not necessary to explain very much about crystal systems, but it is necessary that he should know that it is these symmetrical lattice planes, which obviously exist in all directions in a uniform atom lattice, that are instrumental in producing the X-ray diffraction phenomena with which we are concerned. The spots, rings, and lines which we shall find in X-ray spectra depend entirely for their position and intensity upon the disposition of these crystal planes. There will be one particular pattern for a face-centered crystal, another for a body-centered crystal, and so on. Such then is, roughly, the internal structure of a crystal.

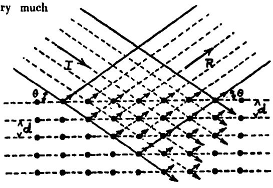

Figure 6: How the X-ray beam is "reflected" by the regularly spaced atom planes of a crystal

The first business of crystal analysis is to show what this structural unit arrangement is and to give information which allows us to calculate the dimensions and the shape of the crystal units. Single crystals, as everyone knows, may sometimes be seen by the naked eye and sometimes only by the aid of a microscope, but we can never hope to see a crystal structural unit by any method; it is too small.

Now we must return for a moment to von Laue's discovery of the diffraction of X rays by a crystal lattice. Experimentally, this meant that when a beam of X rays was passed through a crystal, the component parts of the beam were deflected by the regular atom planes within, and, therefore, if a photographic plate were placed so as to catch and record the emergent beam it would show not only a central spot due to the main beam, but also a symmetrical arrangement of small spots surrounding the center spot and at varying distances from it, due to the components that are deflected by the atom planes.

Von Laue's prediction was correctly based upon the assumption that X rays were a form of light having a definite wavelength. Very soon after the experiments of Friedrich and Knipping, two English physicists, Sir William Bragg[1] and his son, Professor W. L. Bragg, enunciated the idea that X rays would, in a similar way, be reflected by the regular atom planes in a crystal. By the word reflection, however, we are not to understand the same phenomenon as the reflection of ordinary light by a mirror, because X-ray reflection does not take place at the surface of a crystal, but from the regularly spaced atom planes inside it. X-ray reflection really involves this assumption—that a train of X-ray waves, of appropriate wavelength impinging upon an electron, sets it into forced vibration and thereupon causes it to emit a train of waves having the same frequency as the exciting train.

THE theoretical consideration, however, does not matter very much for our purpose. The phenomenon we are discussing may be regarded as that of reflection which, under the correct circumstances, is reinforced in intensity by the succeeding parallel atom layers beneath the crystal surface. What Professor Bragg did, which was of so much importance to practical crystal analysis—in fact, made it possible—was to show that a definite relation exists between the wavelength of the X-ray beam, the distance apart of the atom planes—this, of course, gives the clue to the dimensions and shape of the crystal unit—and the incident angle which the X-ray beam makes with the reflecting plane or planes.

If we examine a crystal of which the atomic spacing is unknown, we may find it by means of the Bragg equation—$n\ \lambda = 2\ d \sin\theta$, where λ is the wavelength of the X rays, d is the distance separating the atom planes and θ is the glancing angle. (See Figure 6, inserted by the Editor.)

It is very easy to arrange the experimental conditions so that the wavelength λ of the X rays is known. It will be seen from Figure 5 how the angle through which the X rays are bent may be measured, and from a knowledge of these two factors we may calculate the spacing of the atom planes responsible for each deflected ray which gives rise to a spot on the photographic plate. It is very important to notice that the conditions expressed in the Bragg equation must be fulfilled before any reflected spot can appear on the plate. In other words, the atom planes must make precisely the correct angle with the particular incident wavelength before reflection can occur.

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[1] An article by Sir William Bragg, on the X-ray analysis, appeared in the *Scientific American* last month.—*The Editor.*

Figure 7: X-ray line spectrum

NOW let us see how this vitally important principle may be employed in the various practical aspects of engineering.

The chief things of importance that may be learned by the engineer from the crystal analysis of his materials are: The size of the crystals, the manner in which the crystal units are oriented, the effect on the crystal lattice of adding small quantities of foreign materials, such as carbon in iron to produce steel, the effect of cold work and annealing on the crystal units, and how far strain in a metal may be detected by X rays. Considerable work has been done on all these questions, and we shall now see what sort of results the X-ray analysis can be made to yield.

There are many different methods of technique in the application of X-ray crystal analysis, but they all depend upon the fundamental principle just explained. It is, however, very important that the most suitable method should be chosen for each particular problem. If we consider a single crystal and an incident beam of X rays made up of several different wavelengths, every set of planes which makes the correct angle with any of the component waves in the beam of X rays will produce a spot on the photographic plate, and a multitude of spots would therefore indicate a large number of participating crystal planes. Further, the arrangement or symmetry of the spots affords a guide to the crystal form.

Sometimes it is not possible to obtain our specimen in the form of a single crystal, and we have to be content with a small piece of metal containing a large number of crystals. If this is the case there is a choice of method depending upon the information we wish to acquire. We may, for example, grind up our specimen into a fine powder and put it into a small thin-walled glass tube. We shall then have, in such complete disorder, a mass of crystal planes presenting every possible angle to the incident beam. This technique is due to two independent investigators—Hull, and Debye and Scherrer. In this method it is customary to pass an X-ray beam of one particular wavelength through a system of, say, two fine line slits for the purpose of obtaining sharp definition before allowing it to fall upon the specimen. A strip of film is arranged in a circle around the specimen on the emergent side, and the results are seen as a series of lines on the film at varying distances from the zero. By applying the Bragg equation we shall find that each line corresponds to one particular set of planes, and we may thus detect any abnormality or distortion in their spacing by a comparison of the results with what is known to be the normal spectrum of the specimen. This method has value in cases where we wish to detect any lattice distortion due, perhaps, to the presence of a foreign element.

Figure 8: "Two more line spectra"

We may, on the other hand, use our metal fragment just as it is and reflect the X rays from it. The method is essentially the same as the previous one and the atomic plane spacing may be calculated in the same way. Care must be observed in preparing the face of the specimen to avoid introducing local lattice distortion by cutting or rough treatment. It is also highly important to remember that the examination of the planes just below the surface may be very misleading and the results by no means true of the material as a whole. X-ray spectra obtained by the reflection method have very valuable applications, but the method is by no means of universal application.

Another method which has very great value in the examination of metals is a modification of the original procedure due to von Laue. A very penetrating X-ray beam is employed, made up of a large number of wavelengths, and the rays, after having been defined by a small pin-hole aperture in the apparatus, fall upon and penetrate the specimen. This usually takes the form of a solid metal plate about one hundredth of an inch in thickness. Here we have a condition exactly the same as in the powder method, in that the specimen consists of a large number of crystals having a perfectly random arrangement. Consequently there will be sets of reflecting planes suitably placed at every conceivable angle. A photographic plate or film is mounted on the emergent side of the specimen.

The information which may be acquired by these pictures is diverse and very valuable. We may determine the crystal size of the material, we may deduce the crystal structure, and we may derive information concerning the orientation of the crystal units which may indicate cold working or strain. The analysis, if carried out subsequent to annealing, will yield important information as to partial or complete removal of orientation or strain, and also show the point at which recrystallization occurs. Characteristic diagrams obtained by this method are reproduced on page 39. They are concentric circles in some cases—Figure 11—and spokes in others. Sometimes the spokes are not very symmetrical, as in Figure 12, and sometimes they have a highly symmetrical appearance, as in Figure 13. In other cases there are no rings, but only a conglomeration of spots. Then, again, in some instances the rings are clear and well defined, and in others they present a somewhat hazy appearance. All these pictures have different meanings, which we will now describe.

FIGURE 11 is the effect produced when the specimen consists of a mass of small crystals with no preferential orientation at all. Here each ring is referable to a particular plane in the crystal which may always be identified.

Figure 14 is the effect produced by a specimen still with its crystal units unoriented, but having much larger crystals.

Figure 15 is typical of a specimen having very large crystals. The rings have entirely disappeared, and each crystal independently reflects the X rays to a spot. There is no preferred orientation.

Figure 12. This picture is quite different. Here we have some suggestion of rings indicating fairly small crystals, but there is an appearance of spokiness or, as it is technically called, "asterism." This appearance is thought to indicate that the crystals are in a state of strain—it shows itself when a metal test piece is pulled in a tensile testing machine, as we shall see later on. It indicates a tendency for the crystal units to orient themselves in a definite direction. This asterism would disappear if the specimen were thoroughly annealed.

Figure 13 illustrates preferred orientation of crystal units. It will be noticed that it is a perfectly well defined and symmetrical pattern. It is, in fact, the characteristic pattern due to the preferred orientation, viewed perpendicularly to the direction of rolling, of a metal having a face-centered cubic lattice. The actual specimen in this case was copper.

Figure 16 is another specimen which has also been rolled and therefore exhibits preferred orientation. Although it is equally well defined, it will be noticed that the pattern is different; this is because they are different crystals. In this case it is a body-centered cubic lattice. The specimen was α iron.

Figure 17 is the same specimen as Figure 15; after having been strained, the crystals have been elongated similar to those in Figure 12.

These few examples will illustrate the sort of information that can be obtained from the X-ray crystal analysis of metals. It would be possible to quote many other examples, but we will content ourselves with a few more illustrations showing the results obtained in some practical investigations. As I said in the beginning of this article, my chief desire is to convey to the engineer a working familiarity with the results of this new method of investigation. For this reason the physical aspect of the subject has been neglected in order that more emphasis might be laid upon the character of the information he is likely to acquire. The technique and its development may be left to the physicist who at the present moment is devoting both skill and time to this work, but if it is to be quickly fruitful the engineer must understand what is being "got at" in order that he may take cognizance of the subject and participate in the interpretation of results from the point of view of the development of his own research.

Questions concerned with carbide in steel; the crystal structure of alloys generally and particularly the brasses; the effect of the alloy elements in modern complicated steels; the differences between good and bad transformer iron; and the structure and properties of electro-deposited metals—all are suitable subjects for X-ray spectra investigation.

My first series of examples are concerned with iron. The specimen was progressively rolled and X-ray spectra were obtained at various stages of the rolling process. Figure 18 is a spectrogram of the original specimen. It shows that the iron had moderately large crystals without any orientation whatever. After rolling to 90 percent of its thickness, a small specimen was cut and X-ray spectra were obtained in three directions: (1) By passing the X rays through it in a direction perpendicular to the direction of rolling—this is the N (normal) spectrogram, Figure 19. (2) By passing the X rays through in a direction parallel to the direction of rolling P (parallel), Figure 19. (3) By passing the X rays through at right angles to the direction of rolling T (transverse), Figure 19. It will be observed that these pictures differ considerably from Figure 18. Some suggestion of rings make their appearance, indicating that the rolling process is beginning to break up the crystals. Further, a general spokiness appears. This indicates a strained condition in the crystals. All three views yield approximately the same pictures.

THE specimen was then rolled to 60 percent of its thickness and three similar spectrograms obtained—Figure 20. We now see a further change making its appearance. The rings are more clearly defined, hence the crystals are much smaller and the general spokiness is beginning to resolve itself into clumps. In the T spectrogram it will be observed that a definite orientation pattern is present. This particular pattern is characteristic of α iron. It is a very curious thing that when iron is rolled, preferential orientation, as indicated by this characteristic pattern, first appears in a direction viewed at right angles to the direction of rolling.

The specimen was then rolled to five percent of its thickness and three more spectra obtained—Figure 21. Here, again, the appearance is different. The crystals are now very small and preferential orientation is apparent in each direction. The rolling has induced the crystal units to take up a definite and oriented position. It is probable that this fully orientated condition is accompanied by a relief of strain which existed in the first two sets of pictures.

Having rolled the specimen to five percent of its thickness, we will now observe the effect of heat treatment on a reverse series of spectrograms. Figure 22 shows the three spectra obtained after annealing the specimen for half an hour at 450 degrees C. (842°F.); it will be observed that no change whatever has taken place. The crystals are still small and the full orientation is present. Figure 23 shows spectrograms obtained after annealing at 500 degrees C. (932°F.); this marks a change point. The general fuzziness of the rings indicates that recrystallization is occurring, and the orientation tends to disappear except in the direction at right angles to direction of rolling—Figure 24. These s obtained after annealing at 850 degrees C. (1562°F.). Recrystallization is now very marked, and the preferential

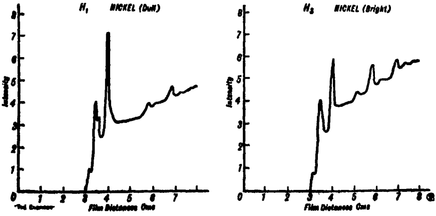

Figure 9: Graphs obtained from the spectra in Figure 7. The peaks in the curves correspond to the spacing of the lines in the right hand parts of the spectra

orientation has almost disappeared in the N and P views, although it is still very strong in the T view—Figure 25. After annealing at 1050 degrees C. (1922°F.) all the pictures now indicate very large crystals, and the orientation is absent except for a small suggestion in the T view, where the crystals exhibit a suggestion of a strained condition. These pictures suggest that until the temperature of 1050 degrees C. was reached, the annealing process was insufficient to remove the orientation from this specimen. A point worthy of notice is that it is in the transverse direction that orientation of the crystallites first makes its appearance, and it is retained in the same direction after it has disappeared in the other two. This series also indicates that this particular method of analysis affords a very sensitive method of determining the effect of heat treatment.

The next series refers to a specimen of manganese steel—face-centered cubic lattice. Figure 26 are the three spectra obtained after rolling. Figure 27 after annealing for half an hour at 600 degrees C. (1112°F.). General fuzziness indicates crystal growth, and the orientation is becoming less definite. Figure 28 shows similar spectra after annealing for half an hour at 1200 degrees C. (2192°F.). The crystals are now large and all traces of orientation have disappeared.

THE next spectra are of a specimen of "Staybrite" steel which normally has a *face-centered cubic lattice*. Figure 29 shows three spectra, N, P, T. The interesting thing to note about these spectra is that the effect of the rolling is to produce a body-centered lattice with its typical orientation. After annealing for half an hour at 600 degrees C. (1112°F.), we obtain the three spectra shown in Figure 30, where the pattern characteristic of a face-centered lattice makes its appearance. These two sets of spectra afford a clear comparison between the two characteristic spectra. In this case the annealing actually destroys the abnormal condition produced by the rolling and restores the normal. As a matter of fact, an expert examination of the spectra in Figure 29 does reveal traces of the normal face-centered lattice, but there is very little of it.

The next series is interesting as illustrating the effect of straining a metal and obtaining information as to what happens to the crystal units during the process. The X-ray tube is in a big protective cylinder, and below is a small arrangement in the nature of a tensile testing machine. The test piece, which is very small and thin, is placed before a pinhole through which emerge the X rays, and weights may be placed on a pan at the extreme end of a beam. Typical spectra are shown in Figure 31, 32, A, B, C, D. The actual specimen was steel. A was obtained before any weights were added. B was obtained after the metal had been stretched to just beyond its elastic limit. Here we have evidence of asterism, and the crystals are smaller; they have been, to some extent broken up by the process. C is a spectrogram obtained well outside the elastic limit. The crystals are still smaller and the asterism is slightly more marked. D is a spectrogram obtained when the metal fractured. Here it would seem that strain has been relieved with a consequent appearance of definite preferred orientation. It is to be noticed that in these experiments there is no appearance of any change until the elastic limit is reached.

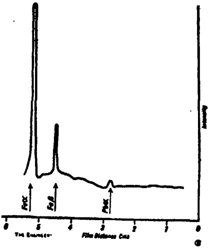

Figure 10: Chemical X-ray method

Figure 7 shows X-ray line spectra obtained by the reflection method. They represent two specimens of electro-deposited nickel obtained by varying the depositing technique. The spectrum marked "dull" will be observed to show several faint lines and one which is very intense. This means that the number of atom planes participating to reflect the rays at this particular angle was very much larger than any other group. As a matter of fact, the intense line is due to the (200) planes, which means that the little crystals of nickel were mainly deposited like little bricks placed regularly side by side. On the spectrum marked "bright," on the other hand, there are at least three intense lines. This indicates that the crystals are not nearly as regularly arranged, but that several groups of planes combine separately to reflect the rays strongly. This means, of course, that the little crystals were deposited with much less symmetry. The specimen of nickel producing the "bright" spectrum was, in fact, much harder than that which gave rise to the "dull" spectrum. This, of course, would be expected.

Figure 9 shows graphs obtained from these two spectra and indicates the relative intensities of the spectrum lines. Figure 8 shows two more line spectra to show the difference in the spectra produced by α and γ iron—body-centered and face-centered lattices. It is often desirable to examine steels by this method to determine the relative proportion of the α and γ structure present. This may be achieved by a comparison of the intensities of the characteristic lines in the spectrum.

THERE is another application of X-ray analysis which has not received the experimental attention that it merits. I refer to chemical analysis by means of X rays.[8] Every element can be made to emit X rays which have a particular wavelength characteristic of the element and of none other. If we wish to analyze a material by X rays we must make our X-ray tube target of that material. The X-ray tube will then, under suitable conditions of operation, yield characteristic radiation which when measured will be recognized as characteristic of a particular element. It does not matter whether the substance to be analyzed exists in a free state or in a state of chemical combination with another. This is one of the important aspects which renders X-ray chemical analysis so valuable in certain cases. The amount of material, too, can be quite small. A recent application of the method in my own laboratory affords an interesting illustration. It was desired to know whether any solder was present in a minute fracture in steel. The fractured steel surface was accordingly mounted as an X-ray target in a special tube and an "emission" spectrum obtained. Certain lines were found on the spectrum characteristic of iron, and also one very faint line in the place where the characteristic line due to lead should appear. The spectrum line is too faint to reproduce in an illustration, but a graph of the spectrum was obtained and is shown in Figure 10. It supplied undeniable evidence of the presence of lead in the fracture.

From the illustrations and short introduction to the subject that has been given, it is hoped that engineers will appreciate the fact that this new method offers very definite promise in practical engineering problems; but, as I have said before, its development must be aided by the specialized knowledge and practice of those chiefly concerned.

The X-ray diagrams which I have used to illustrate the various applications of the method have been obtained in my laboratory by my colleagues, Messrs. D. E. Thomas, C. G. Pollitt, F. W. Osborne, and R. G. Friend.

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[8] An article describing the X-ray chemical method, by Earle E. Schumacher of the Bell Telephone Laboratories, was published in *Scientific American*, December, 1928. Several excellent technical treatises on the X-ray analysis of crystals also are available.—*The Editor.*

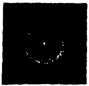
FIG. 11

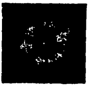
FIG. 12

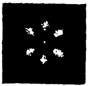
FIG. 13

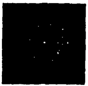
FIG. 14

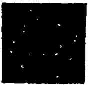
FIG. 15

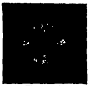
FIG. 16

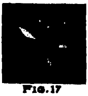
FIG. 17

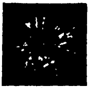
FIG. 18 (UNROLLED)

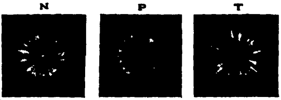

FIG. 19 (90%)

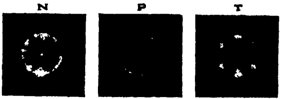

FIG. 20 (60%)

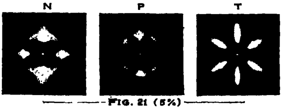

FIG. 21 (5%)

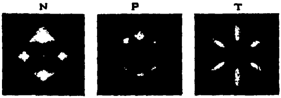

FIG. 22 (450°C.)

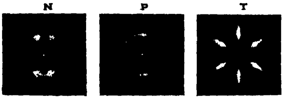

FIG. 23 (500°C.)

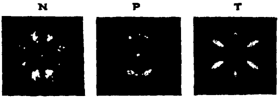

FIG. 24 (850°C.)

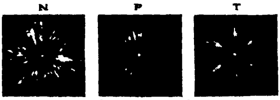

FIG. 25 (1050°C.)

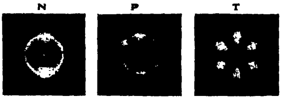

FIG. 26-MANGANESE STEEL

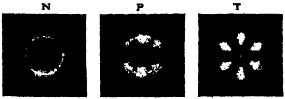

FIG. 27 MANGANESE STEEL (600°C.)

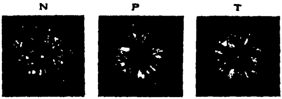

FIG. 28 MANGANESE STEEL (1200°C.)

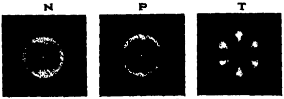

FIG. 29-STAYBRITE STEEL

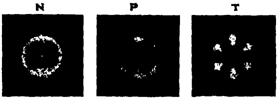

FIG. 30 STAYBRITE STEEL (600°C.)

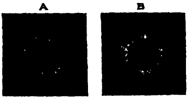

FIG. 31

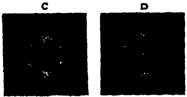

FIG. 32 AT FRACTURE

Figures 11 to 32: Spectrograms explained in the text. The author's article deals with metals and alloys, but the X-ray method (which should not be confused with ordinary X-raying, that is, merely looking through objects) has revealed some surprising facts "concerning the nature of things." It has been learned, for example, that rubber is crystalline, its atoms being geometrically arranged. A thousand common things we never thought of as crystalline proved to be so

PRE-CONSTRUCTED PIPE-LINE HAULED OUT TO SEA*

Five of these eight-ton anchors will hold tankers while they load

WHAT is believed to be the world's largest submarine oil-loading line was launched some time ago for the Standard Oil Company of California in Estero Bay, San Luis Obispo County, California. To laymen, at least, it probably is the most interesting portion of a new oil line leading from one of the most amazing petroleum-producing areas yet known to the industry, the Kettleman Hills.

In order to provide an outlet for oil produced in the Kettleman Hills, the company has constructed a 10-inch trunk pipe-line from this field to the Pacific Ocean, a distance of 70 miles. Oil from the wells is collected through field lines to a central gathering station located near Kettleman City, where it is passed through rectifiers to remove dissolved gases. Heavy-duty steam pumps, operating at a thousand pounds pressure, then force the oil through the trunk line direct to storage-tanks on the coast. There are no intervening booster stations along the line. The high-pressure direct pumping is possible because the line is constructed of seamless pipe. All of the field joints are welded—there is not a screwed fitting or joint in the entire line.

THE western terminus of the line is at Estero Bay, about 15 miles northwest of San Luis Obispo, near the town of Morro Bay. A station has been constructed here to load the oil into tankers which will carry it to the company's refineries. The site of this loading station approaches the ideal. The storage-tanks, which receive the oil from Kettleman Hills, are located about a mile from the beach on the top of a ridge that rises south of a small stream-bed called Toro Creek. The ridge is flat-topped, affording ample space for a large amount of tankage, which can be constructed with very little excavation. Four large tanks equipped with floating roofs have been installed on the ridge. They are concealed from the highway, which lies along the beach, by a shoulder in the hills.

Oil is loaded into tankers directly from the storage-tanks on the ridge. For this purpose, instead of building a wharf which, in the open bay, would be exposed to damage by storms, the company has constructed a submarine line that cannot be damaged by rough weather and which provides a more economical means for loading.

This submarine line consists of 16-inch welded steel pipe extending from the beach along the bottom of the sea to a point 3000 feet out in the ocean, where the water is deep enough to provide safe anchorage for the largest tankers. The shore end of the submarine line is joined to the tanks on the hills through a 20-inch pipe. A flexible rubber hose is connected to its sea end. When not discharging, this hose lies on the bottom, but it is arranged so that its end can be readily picked up to the surface by tankers for loading.

The launching of the submarine line and the installation of the marine equipment were done under contract by the Pacific Bridge Company. Preparatory to launching, the entire 3000 feet of 16-inch pipe was welded together into one long tube weighing about 300,000 pounds. This was placed on low cars running on a small industrial railroad-track that the contractor had laid on the floor of the valley of Toro Creek, which slopes gently back from the edge of Estero Bay. When all was in readiness, a steel towing cable was brought ashore from the Red Stack tug, *Sea Salvor*, anchored about 2000 feet off shore. This cable was attached to a pulling bridle secured to the end of the pipe-line. A sled to guide the line over any obstacle such as rocks was also firmly lashed under the end of the pipe-line. At a given signal, the *Sea Salvor* pulled the pipe-line out along the ocean bottom. When the line was in position, it was anchored with chain weights at several points along its length. It was secured on the beach by

Two photographs illustrating the manner in which the pipe-line was made ready for launching by welding it into a single piece over half a mile long

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*Reprinted by permission from the *Standard Oil Bulletin*.

means of a heavy concrete block cast around the pipe.

After a hydrostatic test showed that no damage had occurred during the launching operation, a diver's crew installed the flexible hose at the sea end of the line. This hose is made of rubber, heavily reinforced with a spiral steel wrapping. A lifting bridle is connected to the end of the hose by a chain attached to a buoy.

Five enormous anchors, each weighing 16,000 pounds, were placed in a semicircle about the end of the submarine line to provide moorings for the tankers while loading. The tankers will not tie directly to the anchors, but will secure their mooring lines to big can-buoys attached to the mooring anchors by means of heavy forged-steel chain. These moorings were designed to hold the company's largest tankers in rough weather.

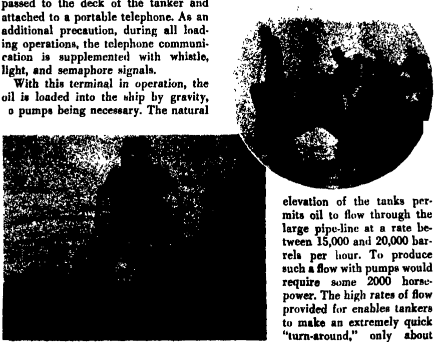
The floating telephone station. The buoy with ***its extension line supports a flexible conductor that is connected to the armored submarine cable***

A bell-buoy was installed near the mooring site by special permission of the Bureau of Lighthouse Service. The sound of the bell warns other craft that they are approaching the submarine line and acts as a guide to incoming tankers in foggy weather.

To facilitate its progress over the ocean floor, the forward end of the pipeline was equipped with a sled. The pulling bridle is here shown in place

IN order to provide reliable communication between the shore station and the tankers loading at this terminal, an armored telephone cable was laid from the beach to the moorings, parallel to the submarine pipe-line. A flexible conductor spliced to the end of this cable is secured to a small buoy on which several hundred feet of telephone wire are coiled. During loading, this wire is passed to the deck of the tanker and attached to a portable telephone. As an additional precaution, during all loading operations, the telephone communication is supplemented with whistle, light, and semaphore signals.

With this terminal in operation, the oil is loaded into the ship by gravity, no pumps being necessary. The natural elevation of the tanks permits oil to flow through the large pipe-line at a rate between 15,000 and 20,000 barrels per hour. To produce such a flow with pumps would require some 2000 horsepower. The high rates of flow provided for enables tankers to make an extremely quick "turn-around," only about six hours being required to load even the largest vessels.



In circle and above: **One of the divers who served on the job, at work and in repose**

To insure accurate control of the oil being loaded at these high rates, a control gate-house has been located at the foot of the hills near the beach. All the ship-communication equipment is located at this control house, together with an electric-flow meter which will give a continuous indication of the rate of flow. A 16-inch cast-steel, motor-driven valve located at the house is used normally for adjusting the rate of flow to the ships. A similar hydraulically operated valve equipped to close quickly without setting up a dangerous surge in the pipe is also installed here for emergency shut-off. The controls for these valves, together with the flow meter and all the other instruments, are centralized at a desk in the control house. Here the operator, with an unobstructed view of the ship with which he maintains continuous communication, can control the flow of oil at a finger's touch.

In planning the design and operation of this loading terminal, every possible precaution was included to guard against the spilling of oil. The United States Army engineers, in granting a permit for the installation of the submarine line, indicated that they were satisfied with the precautions made so that no oil would be released to contaminate the beaches in the vicinity. Not only have numerous precautions been provided against spills occurring during loading, but also a set of tanks and pumps is installed near the shore end of the submarine line, into which any oily ballast or bilge-water the ship may contain when she comes in to receive a cargo at this port, can be discharged. All the oil will be skimmed off these tanks so that nothing but clean water is discharged into the ocean.

GIANT TORTOISES

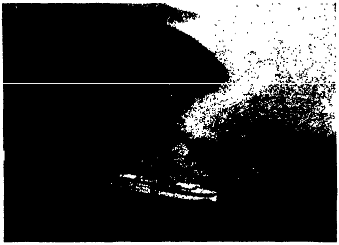
Nearing Extinction on the Galapagos Islands, They Are Being Propagated in the United States

By DR. CHARLES HASKINS TOWNSEND

The author and a tortoise on board the Fisheries steamer, *Albatross II*

THE point of greatest interest in connection with the Galapagos Islands and their indigenous animal life is the existence of land tortoises of prodigious size, and formerly, in amazing numbers. Dampier, who visited the Galapagos in 1684, says of the tortoises: "It is incredible to report how numerous they are." Similar affirmations regarding their abundance are to be found in the accounts of the early navigators who followed him. It was this outstanding feature that gave the Galapagos* Islands their name. The abundance of large tortoises attracted to the islands food-seeking ships for three centuries—an attraction that persisted until the exhaustion of the supply.

With the wondrous tide of tortoise life brought to a low ebb in the 19th Century by man, there followed no rise when he withdrew. The pests he had introduced proved sufficient to prevent an increase among the scattered survivors. Dogs, pigs, cats, and rats abandoned there, returned to the feral state and increased to thousands. The eggs and newly hatched young of the tortoises became their food, few escaping. The adults, wearing their shell armor, were largely immune. Then followed the Ecuadorians, who killed tortoises assiduously for their oil. The animals have long been extinct on most of the islands where they once swarmed. Wild dogs and other predatory pests roam in thousands on the two large islands, where limited numbers of adult tortoises are still to be found—mostly in high country far inland.



The Astor yacht, *Nourmahal*, on which the author visited Galapagos Islands in 1930, in a cove at Albemarle Island

TORTOISES are still hunted occasionally by Ecuadorians of the two small settlements remaining on the Galapagos. Therefore, their continued existence on Albemarle and Indefatigable Islands can hardly be expected.

With these facts under consideration, the board of managers of the New York Zoological Society authorized the writer, who had twice visited the Galapagos, to procure, if possible, a breeding stock of tortoises for colonization in our southern states and elsewhere under favorable climatic conditions. With the co-operation of the United States Bureau of Fisheries, the steamer *Albatross II* was sent to the Galapagos in April, 1928, under my direction.

The success of the expedition greatly exceeded our expectations. One hundred and eighty tortoises were captured in the mountains of southern Albemarle, which involved a week's journey with pack animals. We secured the services of twenty Ecuadorian colonists at the hamlet of Villamil, who with their burros made an effective collecting party. It was not practicable to transport any tortoises of large size in this exceedingly rough and trailless country. The loading of the tortoises on the ship was extremely difficult, as the coast is exposed to a heavy swell and the *Albatross II* lay two miles off shore.

Most of the tortoises brought back were soon placed in colonies along the southern border of the United States. All are in the keeping of zoological gardens or other responsible co-operating agencies. These are located as follows: four colonies in southern Florida; others at New Orleans, Louisiana; Houston and San Antonio, Texas; Superior, Arizona; and San Diego, California. Other colonies were later established in Bermuda; Honolulu, Hawaii; and Sydney, Australia. All have the freedom of fenced, grassy ranges and are provided with dry shelters, to which tortoises can retreat during chilly weather or periods of unusual dampness. A number of small tortoises are retained at the New York Zoological Park until they attain larger size. Like the others, they will be placed only with responsible organizations in the south, co-operating with the New York Zoological Socie

THE great tortoise of Aldabra Island in the Indian Ocean has a history similar to that of the Galapagos tortoise. It w for food by mariners for more than three centuries, when, threatened with extermination, its propagation was undertaken under the auspices of the British Government. Distributed among the farmers of the adjacent islands of the Seychelles, it was domesticated and soon became a valuable food animal. The New York Zoological Society is hopeful of similar success with its congener of the Galapagos.

While a distinct species of tortoise has been recognized on each of the ten islands of the Galapagos group that originally bore them, five have been described from the large island of Albemarle, which is probably too many. Albemarle has a length of 75 miles and heights up to 5000 feet. Each tortoise in the colonies established by the Zoological Society wears a copper number and has been measured and weighed. These records will be continued annually for a number of years until the rate of growth and change with age are determined. In this way one of the many problems connected with the very peculiar animal life of the Galapagos may be advanced toward solution and some of the present confusion respecting species of tortoises eliminated. The origin of this isolated fauna is still unknown. The islands belong to Ecuador and lie 500 miles from the nearest part of the mainland.

WHILE at Charles Island we obtained from a cave a dozen large skeletons of the long-extinct tortoise of that island. These skeletons have served to establish the identity of the Charles Island tortoise as *Testudo galapagoensis*, a species long involved in uncertainty. It became extinct there in 1848. Twelve whaleships that participated in its extermination carried away 1775 tortoises, according to logbook records in my possession.

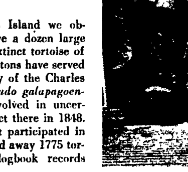
We were assured by natives of Albemarle that tortoises of large size are still to be found in the high interior of Indefatigable, an island having a diameter of about 25 miles. This island is one of the most difficult of the group to penetrate. Available records show that the catches of tortoises made here by the great whaling fleet of the 19th Century were small as compared with those made on more accessible islands.

The tortoise of Indefatigable is known as *Testudo porteri.* Few naturalists had studied the indigenous animals and plants of this island until the arrival of Mr. Astor's yacht, *Nourmahal*, early in 1930. Like the others it suffers from the plague of introduced pests, and the remnant of its tortoise life is probably destined to disappear.

While on the way to Albemarle in 1928, the *Albatross II* stopped at Duncan Island, where a party of ten men sent ashore from Mr. W. K. Vanderbilt's yacht early in 1928 had obtained five tortoises. Our party of eight men spent two full days exploring its steep thorny slopes. We examined both lower and upper craters and reached the top of the mountain without finding any trace of tortoises. This small but exceedingly difficult island has been frequently visited and has yielded occasional tortoises up to the present year. It is possible that Mr. Vanderbilt's party captured almost the last of those living there.

Duncan Island furnished hundreds of tortoises to whaleships as late as the middle of the last century, when four vessels took away 356 tortoises between 1848 and 1863. Tortoises were reported to be plentiful there when explored in 1906. Man is their only enemy on this island except rats, which accounts for their persistence on an island only three miles long. Other domestic animals, if ever introduced, probably did not survive the dry season. The island is waterless except during rains. The tortoise of Duncan Island (*Testudo ephippium*) is well represented in museum collections, and the New York Zoological Park has three living adults, the gift of Mr. Vanderbilt.

Mr. Astor's party on the *Nourmahal*, with specimens of the young tortoises of Indefatigable Island. This species of tortoise was long supposed extinct



This 415-pound Galapagos tortoise (mounted) was raised in California

The species represented by our collection from the mountains of southern Albemarle is probably *Testudo vicina.* It has not yet been compared with other species described from that island. It seems to have disappeared from the low country. We found no traces of it, and hunting by passing vessels was discontinued years ago.

The former importance of the Galapagos tortoise as a source of food is but little understood at the present time. The narratives of the early navigators who visited the Galapagos all contain references to it. Great numbers of tortoises were taken for food by buccaneers, sealers, merchantmen, and whalers.

Among the logbook records of the whalers examined by the writer at New Bedford and elsewhere were those of 105 whaleships that carried away 15,830 tortoises during a period when there were 700 vessels in the American whaling fleet. Many of the whaling vessels made catches of 300 or more, one in 1834 taking 500. The extent to which it was used as food cannot be known until more logbooks can be examined.

Tortoises were kept on board without food or water for months, in some cases more than a year, and killed as required. The narratives of the early navigators and the logbooks of the whalers contain only favorable testimony regarding the edible qualities of the giant tortoise. Admiral Farragut, who served as a young officer on the U.S.S. *Essex*, at the Galapagos in 1813, wrote: "The meat cooked in almost any manner is delicious."

IT has been estimated that ten millions of tortoises have been taken from the Galapagos since their discovery. The Galapagos tortoise had apparently a food value to the Pacific whaling fleet for the best part of a century, not unlike that of the bison to the settlers of the great plains. It was known to the whalers as terrapin, a name usually spelled "turpin" in their logbooks. The giant tortoises still in existence on the Galapagos and on Aldabra are of great interest to naturalists. They represent the only survivors of extinct tortoises that in a very remote past inhabited North America and India.

The tortoises now colonized at points near the southern border of the United States are young and mostly of small or medium size, few weighing more than 150 pounds. They have already shown gratifying growth, the degree of which undoubtedly depends upon extent of range and access to grass or other food at all times.

The colony of tortoises at San Diego enjoys a well-fenced range of about five acres of hillside in the zoological garden. This area is well supplied with coarse grasses and low bushes, and has a few trees.

The tortoises at the Boyce Thompson Southwestern Arboretum, Superior, Arizona, have half an acre of desert land thickly grown with cactus—their favorite food, a concrete drinking basin, and a stone refuge during chilly weather. A 50-pounder here increased ten pounds in three weeks on a diet of prickly pears.

The three colonies located in zoological gardens at San Antonio, Houston, and New Orleans, have grassy ranges averaging about a quarter of an acre in extent.

UNTIL recently, there has been little information on record respecting the growth of the giant tortoise. A 29-pound male (*Testudo vicina*) taken from Albemarle Island in June, 1899, lived at Riverside in southern California, until April, 1914, when it died from exposure on wet ground. Its weight at death was 415 pounds, the carapace measuring 41 inches. It is also recorded that this tortoise increased from 29 to 350 pounds in seven years. It practically doubled its weight annually while young. Mounted, it is shown in the photograph on the preceding page.

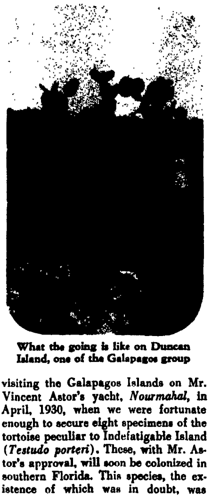
A tortoise of the same species was received at the New York Zoological Park in 1904, its weight being 140 pounds. It weighs at the present time (1930) only 360 pounds. Lacking in winter the outdoor life enjoyed by the California tortoise, its growth has been very slow. Nevertheless, it is a healthy and powerful animal, easily carrying a full-grown man.

We have now many young tortoises colonized at several points under various conditions and all in mild climates. As all have been numbered and weighed, we have already acquired definite knowledge as to rate of growth. Reports from these colonies show that tortoises under 20 pounds practically double in weight each year. The growth of those exceeding 50 pounds has been slower.

Should these animals increase in numbers, under the present experimental conditions, as is expected, the Zoological Society will eventually arrange to make them available to breeders as food producers suitable for propagation in southern and especially in arid regions.

Nature (London) in commenting on the attempt to propagate the giant tortoise says: "The only hope of keeping the stock alive was to establish it in conditions where its safety and continuance could be assured so far as human devices go."

The writer enjoyed the privilege of visiting the Galapagos Islands on Mr. Vincent Astor's yacht, *Nourmahal*, in April, 1930, when we were fortunate enough to secure eight specimens of the tortoise peculiar to Indefatigable Island (*Testudo porteri*). These, with Mr. Astor's approval, will soon be colonized in southern Florida. This species, the existence of which was in doubt, was found far inland. Certain large specimens, too large for a horse to carry, were left at liberty. Those brought out weighed from 40 to 80 pounds. We measured the bleached shells of several killed years before that were nearly five feet in length of carapace as measured over the curve. They must have weighed considerably over 500 pounds.



What the going is like on Duncan Island, one of the Galapagos group

The following record from San Antonio, Texas, shows the increase in weight during two years of eight young tortoises located there:

Tag No.	Weight Lbs. 6/11/28	Weight Lbs. 7/1/30
75	12½	34
76	10¾	32
77	10¼	36
78	12	—
80	10½	38
84	10	38
86	32	62
89	13½	40
—	111½	316

Other records recently received are here presented without details, showing only increase in total weight of each colony of young tortoises:

Locality	No. of Tortoises	Weight in pounds 1928	1929	1930
San Diego	7	479		1041
Houston	14	192		709
New Orleans	7	101		286
Bermuda	10	66		175
Honolulu	6		159	378

Records from two other stations show similar rates of growth, while reports from four localities have not yet been received.

LET us consider this huge, slow-moving animal it is proposed to domesticate. It is a vegetarian, amazingly fond of cactus, which it eats spines and all, but in captivity is ready to eat grass or any vegetables set before it. It does not bite or make a noise. It doubles its weight annually while young and continues growing indefinitely when old, until weights of 500 pounds or more are attained. The females lay 20 to 40 eggs. The young shift for themselves. This tortoise is good to eat, as attested by the mariners who captured it. Let us at least prevent the extermination of the giant tortoise even if it cannot take rank with other domesticated food producers. Its origin in its isolated volcanic home is one of the unsolved problems of the Galapagos Islands, so interesting to all naturalists since Darwin in 1834 made observations there which have never been surpassed in zoological interest.

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¶ Commercial applications of the Diesel engine in the automotive field will be the subject of an article to appear soon.—The Editor.

A Duncan Island tortoise *(Testudo ephippium)* now in New York

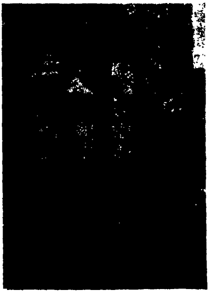
FROM THE ARCHEOLOGIST'S NOTEBOOK

New Allenby Bridge Makes Petra Accessible

PETRA, the wonderful sculptured city of the desert, was for a long time inaccessible because of its remoteness and the danger from roving Bedouins. It can now be reached with comparative comfort by means of the Damascus-Mecca railway. One can now travel down from Jerusalem by motor to the Jordan, and hence by the new Allenby Bridge to Amman, the capital of Trans-Jordania. A train leaves twice a week for Maan, 120 miles distant. From this point camels or horses can be hired and the ruined city reached in about six hours.

The North Arabian Desert was always difficult to cross by reason of the juxtaposition of great barriers of granite and sandstone athwart the line of communication between the various cradles of the human race—between Egypt on the one hand and Syria, Mesopotamia, and southern Arabia on the other. At a time when maritime enterprise still hesitant and fearful, man was forced in his infancy to seek a way through the desert. Petra was ideally situated geographically to form a clearing house for the commerce of the world as it was then. The land route from southern Arabia via Mecca to the countries of the Mediterranean was all-important for the supply of luxuries of life—"gold and silver, ivory, apes and peacocks" which the rapid development of civilization demanded. Petra began to establish a position as a cosmopolitan emporium about the 6th Century B.C. and retained this position for almost one thousand years. The City of Petra probably reached its greatest wealth and prosperity in the 1st and 2nd Centuries A.D. under the Romans. The east and west traffic became gradually diverted to a more northerly route by Palmyra and the north and south traffic probably took a line farther east, something like the Hajj route or the "Pilgrim Route" from Damascus to Medini, and very much along the line of the present Hijaz Railway.

Petra is unique among the wonders of the Orient, being hewn out of the solid rock. The remains include native, Egyptian, Greek, and Roman art. The rock is beautifully colored which gives much light and vivacity to the 850 known temples, monuments, and tombs.


This beautiful structure, hewn out of the solid rock, is 70 feet high

The monastery, carved out of solid rock, is surmounted by a huge

A most elaborate survey of the city has been recently made by Sir Alexander Kennedy whose researches have been published in a beautiful book entitled "Petra: its History and Monuments." The so-called Treasury of Pharaoh is a magnificent ruin and is one of the latest, dating from the time of the Emperor Hadrian who visited Petra in 131 A.D. The structure is about 70 feet high. A rock-hewn stairway of many hundreds of steps brings one to the largest of Petra's ruins, the El Deir or monastery. It is nearly 150 feet high and is surmounted by a huge urn which we also illustrate.

Chinese Pottery Dogs

THE antique pottery dog in The Metropolitan Museum of Art is interesting as it shows a breed which has apparently been known in China since the earliest representation of dogs. Similar dogs existed in the 1st Century A.D. and exist in the flesh at the present day. The attitude and spirit of the animal have been caught perfectly—a little lonely and forlorn, as out-of-doors dogs apt to be ii

An old Chinese artist caught the spirit of an abused unpedigreed dog

A Venus from the Sea

OCCASIONALLY the sea still give up works of art. A marble statue of Venus has been recently recovered from the water near the island of Rhodes in the Mediterranean Sea. The head was found first and the body was recovered after further search. It is a new type of Aphrodite, of which there is only one other known example. It has been placed in the Rhodes Museum. Our illustration shows the body of the statue being hauled out of the water.

At the left a 10-ton tree is being skidded over the garden wall. *Below:* Moving a large olive tree on a motor truck. When planted, this tree gave the appearance of having been planted more than 50 years ago by mission padres

LANDSCAPING WITH FULLY GROWN TREES

By H. L. POPENOE

TRANSPLANTING large trees to secure an immediate effect is a common practice among landscape designers and planting contractors throughout the country, but its adoption by the man of limited means ha[illegible] yet become general. This is chiefly due to the necessarily large expense and the risk connected with the und[illegible]aking, but it is also due to the fac[illegible]hat special equipment plays such a[illegible] important part in the handling [illegible] the

The special equipment desirable for the easy and safe moving of large trees includes a derrick or large tripod, a chain hoist of sufficient strength to lift the tree from its place of growth and to settle it into its new location, and a truck or cart adapted to easy loading, capable of carrying a heavy weight. Block and tackle, rollers made of short lengths of pipe, bars, lifting jacks, ropes, and similar small equipment all come in handy when getting the tree into place.

Horticultural ability or training is even more necessary than the proper equipment for if the tree mover is not a judge of proper conditions, varieties, and methods, his chances for failure are multiplied. It seems almost criminal to uproot and move a tree that has taken years to grow, only to have it die.

One of the illustrations shows a three wheeled cart used by the writer, that has proved handy for moving balled or boxed trees as well as those that are moved "bare root." It is built low to make loading easy and is strong enough to carry a load of two or three tons. A brake lever working on a drum on one of the wheels prevents it from going [illegible] fast down hill.

The tree is lifted by a tripod and chain hoist until the cart can be pushed beneath. The tree is then lowered onto the cart, and hauled to the new location by team or truck.

IN making the cart, a heavy trailer axle and wheels were bought at an auto wrecking yard. The axle was two inches in diameter and the wheels were equipped with roller bearings and plain steel tires. In order to make the platform sufficiently wide, the axle was lengthened one foot by welding on a piece of steel. The platform was made of two-inch plank strongly braced with angle iron and iron rods and was attached to the axle with U bolts. The front wheel was arranged like a caster, and iron braces were extended from the king pin to the axle on each side. The wheel itself was made from a section of log with a heavy tire shrunk on and a pipe boxing set in. It cost approximately 35 dollars to build the cart.

Another truck for moving tall trees has a "reach" consisting of two 4 by 6 timbers, 20 feet long, connecting the front and rear axles. These timbers are four feet apart at the rear axle but run together at the front axle. The rear axle is seven feet long so that the rear wheels will readily straddle a fair-sized hole.

To load this wagon, the front wheels are removed and the reach is raised to a vertical position against the tree trunk. After blocking the wheels, the reach is carefully lowered to a horizontal position and the front wheels are replaced. If the spread of branches is wide, it is often necessary to build a cribbing between the trunk of the tree and the reach so that the branches will clear the ground.

After reaching the new location, the operation described above is reversed. The raising and lowering is accomplished by means of jack screws and cribbing, or if the tree is very heavy, with block and tackle.

In transplanting tall trees, guy wires or ropes are used as a safety precaution while raising and lowering the tree and these are left after the tree is planted until the earth has had time to become firm and the roots have taken hold of the soil. Otherwise damage may result from hard winds. Where the guy wires are attached to the branches they are run through a piece of hose or over some pieces of wood to protect the bark from damage. A coat of whitewash is applied to the trunk and larger branches to prevent sun-scald.

A very good time to cut back and thin the top of the tree to be moved is before it is raised to an upright position in its new location. If it is a deciduous tree the top may be cut back, leaving a few of the healthy, shapely branches. Each cut, so far as possible, should be at a crotch or lateral, and the wounds should be covered with an asphaltum or tree paint. In the case of broad leaved evergreens it is best not only to thin the branches, but to strip off most of the leaves as well. With this treatment trees that are ordinarily difficult to move, such as holly, can be moved successfully.

The object of this severe cutting back is to balance up the top with the root system, which is appreciably cut in digging. If the top is not cut back, the evaporation from the leaves and branches takes place more rapidly than the roots can supply moisture, and the tree would become so exhausted that even if it did not die, its growth would be seriously checked.

A TREE to be moved "bare be handled with greater safety on a damp or cloudy day as then the roots do not dry out rapidly. It also saves many of the fine roots—to the ultimate benefit of the tree—if it is moved with a frozen ball of earth around the roots. This is a method in common use with conifers, where moving is done in winter.

In warm climates the same effect is secured by boxing. This permits the moving of medium-sized or small trees without serious shock and at a season when it would otherwise be impossible. It also permits the tree being held for sale, already established and in growing condition, without danger or loss. Such specimens have a much stronger appeal to the average planter than the same tree would have standing dorn bare.

Boxing, especially from loose ground, is more easily accomplished when the earth is dug away from the ends of the proposed cube of soil leaving the sides intact. A tunnel the width of the box is then cut through under the tree and the bottom boards slipped in one at a time until all are in place. The end boards, already cleated together, are next set in place and nailed to the bottom. It is then possible to cut down the sides of the cube and board them up to the ends without letting the soil fall away from the roots. After filling all spaces left between the cube and the boards with loose soil and tamping it, the box is ready for moving. If the diameter exceeds three feet, the box is made of two-inch lumber held together by three-eighths inch iron rods that have been run through the sides and bolted, or by hooks bolted through the sides and held together by wire. This prevents wrecking the box while moving.

To remove the box from the hole, a tripod of 4 by 6 timbers, 20 feet long, is set over it and a three-ton hoist raised into place with a rope and pulley until it may be hooked into a heavy iron ring at the top. The other end of the hoist is then hooked into chains or cables that are made fast to the box. Box and contents may now be moved to their new

a plank track on rollers made of short lengths of gas pipe. The tripod and hoist again come into service to lower the tree into the hole which has been previously dug deeper than the depth necessary and partially re-filled with a mixture of well-rotted manure and soil. Fresh manure is never allowed to come in contact with the roots and if used, it is covered with several inches of soil before setting the tree in place. The sides and ends of the box are then removed but the bottom may be left in the hole to rot, if it cannot be easily removed.

AS the soil is replaced about the roots of a transplant, it is well settled by tamping or with water. On bare root trees nothing can equal water for settling the soil and filling the air pockets under the roots.

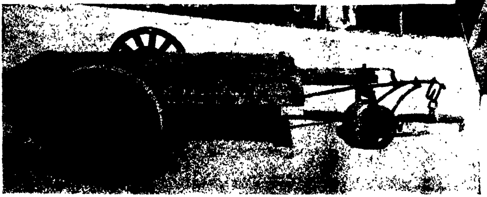
In the selection of a tree for transplanting, it is obvious that one should pick a vigorous, healthy one. If it has grown in a location where it had to send its roots a long distance to food and moisture it will not have a compact root system and most of the fibrous feeding roots will be lost when digging it out.

One that has grown along a river or creek in alluvial soil will have an abundance of good roots close to the trunk and can be moved successfully. Trees that have been previously transplanted, such as nursery grown trees, usually have compact root systems. Root-pruning the growing stock in the nursery row is a common practice, and not only makes transplanting easier but increases the chances for success. The tree with plenty of young fibrous roots recovers quickly and easily from the shock of moving, but trees with old wood are slow to start growth, and often die after struggling along for three or four years. For this reason it is well to prepare a tree a year in advance for moving by cutting back both top and roots enough to stimulate new growth close to the trunk.

THE time for moving a tree is governed by its dormant period. Deciduous

greens all are at a stand-still during cold weather and may be moved during the winter months, while some conifers and evergreens are dormant in late summer, putting out a fall growth after the rains start. Palm trees succeed best if moved during hot weather in late summer, for at this time there is little danger of the roots decaying before they take hold of the soil.

The loss of an occasional tree is inevitable. The percentage of loss may be reduced, however, if the trees are carefully watched during periods of dry or hot weather, and given plenty of water. And the occasional loss is more than balanced by the satisfaction of having gained years in the development of the home grounds.



At the left may be seen the tree wagon described in the text. Above is a chain hoist and tripod used in tree moving

ON THE TRACK OF THE MAYAS

An example of the best Maya sculpture from the ruins of Copan

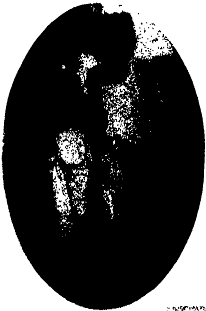
THE Maya Indians of British Honduras are a people who, nominally Catholics, fuse paganism and Christianity in a delightful fashion. In their religion, Dios has to look after the whole world while the old Maya gods Huitz-Hok, the gods of the mountains and plains are very powerful—locally! There are the Virgin Mary, St. Anthony, St. Louis, and so on, all mixed up with the morning star, the thunder gods, the wind gods, the moon, the sun, water, and the spirit of vegetation.

The priests have hard sledding when they have to cope with Mahanamatz, a gorilla-like mythical animal which is said to have the same features as a man but is extremely hairy. These animals are supposed to live in rocky areas in motest part of the forest and stand pright. They are said to walk with their big toes turned backwards. If one f these animals catches a person it him open with its huge shaggy paws. It is useless to shoot it as the shot will not penetrate its thick coating of hair. The only hope of salvation lies in setting fire to it.

THERE exists among certain Mayas a curious belief in a monster that closely resembles the classical centaur. These monsters are said to be a cross between Germans and mares. Probably garbled accounts of the old Spanish cavalry handed down for centuries are responsible. The animals are harmless and have no occult powers. Black magic also flourishes sub-rosa and altogether the *Pater Noster* and the *Credo* have unfair competition.

The above and the following interesting information was gleaned from J. Eric Thompson's "Ethnology of the Mayas of Southern and Central British Honduras." Mr. Thompson's publication is the result of four visits paid to British Honduras, the two last being in the interests of the Field Museum of Natural History, where he is Assistant Curator of Central and South American Archeology. The present population of British Honduras is small (estimated at 46,000 in 1923) and is extremely mixed, the bulk of the population being negro. The Maya-speaking population of the whole colony is 7806 (figures for 1921). There are a number of Indians in the western and northern districts who have unfortunately lost their language and now speak only Spanish.

One of the interesting stories showing the psychology of the Indian is related by Mr. Thompson. In 1883, some of the Mopan Maya inhabitants of the town of St. Luis, Petan, irked by constant taxation and military service, resolved to cross the border and live in British Honduras. They settled in a spot that is now known as San Antonio. Things did not go so well in the new community, crops were bad and fever was rife. A council was called and the unanimous decision was that the troubles were due to the fact that their old saints no longer protected them. It was decided that the saints should be seized from San Luis.



The distance between the two towns was 45 miles. At 9 P.M., when San Luis was asleep in its hammocks, the army descended. Only half the force did the plundering while the rest remained in reserve. Only axes were needed to force the church door. It was the work of a moment to seize the coveted statuettes as well as the church bells. The next night the saints had been installed in the little palm-thatched hut that served San Antonio as a church, and the stolen bells chimed across the hills to summon the inhabitants to hear the story of the "bloodless rape of the saints," as Mr. Thompson humorously calls it. A counter-attack was in order, the invaders from San Luis were arrested and after promising to make no further attack on San Antonio were released. The saints apparently preferred their new abode, for disease decreased and crops improved.

THE Maya communities of southern British Honduras are typical of their nation in that their whole life centers around agriculture. Their very existence is bound up with the crops. The clearings on which they grow their produce are known as *milpas* and are three or four acres in extent. In addition to the *milpa*, each family has a small patch of cleared land which is permanently under cultivation and in which perennials such as oranges and cacao are cultivated, but the pigs kept by every family make crop cultivation a gamble. The range of fruit trees, vegetables, and cereals grown by the modern Maya is wide, covering, as it does, in addition

In the oval are two Maya boys wearing masks used in a ceremonial dance. *Below:* An Indian child of San Antonio, in native dress, carrying a piece of sugar cane which he chews as candy

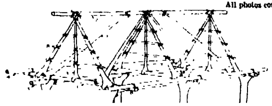
to the staple products of his pre-Columbian ancestors, a varied collection of plants introduced in colonial and more recent times.

The site of the plantation is often 8 or 10 miles from the village. After raising one crop the land is usually abandoned for 7 or 8 years to allow a second growth of timber to form. The land is cleared and sowed by groups who help each other. The evening before felling is to start on each plantation the members of the communal group gather at the house of the man whose land is to be cleared. There a vigil is kept up the whole night. Entrance to the "wake" is not confined to members of the group; friends may drop in, or members of the group be absent. Chicken, pig, tamales, tortillas, and so on, are served with cocoa, rum, and a drink called *posole*. cordions, harps, or marimbas are produced and the night passes pleasantly enough.

At dawn the owner sets alone, for he must perform certain ceremonies before the others arrive. Setting fire to a few pieces of wood in the center of his patch, he places on the flame a lump of copal incense while he offers [illegible] gods. After cutting, the timber and brush are left about three weeks to dry before burning off. Another vigil with chicken, cocoa, and rum takes place. After the burning, a light rain is required to lay the ash and soften the ground for sowing. This can usually be depended upon during the first week in May.

ALL the religious devotion of the San Antonio Maya seems to be confined to the milpa. When it comes to marriage, however, it is with benefit of clergy. The men usually marry before the age of 20; the girls as a rule are married before they reach 16. Polygamy is never practiced. Divorce is unknown, but desertion is common. Cruelty is not un- ly shown towards women, but never to children. The Easter festival is far from being dry and the gentlemen drink while the ladies wait outside to help their drunken husbands home. The ceremonies connected with death and burial are simple. The corpse is buried as soon as possible, usually without any prayer. A coffin is seldom employed and the Indians say that a man buried with a coffin will have to carry it all the way to Heaven.

All photos courtesy Field Museum of Natural History



A typical structure built by May workers without the use of nails, vine rope being used. The draw the principles of construction involved

The most important activity of the Indians, aside from their agricultural pursuits, is hunting. The bag may include the peccary, deer, howling mon- [illegible] with outlandish names that convey no *meaning* to the uninitiated. The Mayas usually hunt with modern shotguns, although blowguns are used to some extent and bows and arrows are used for sports. Hunting parties of two to nine go far afield and Huitz-Hok is invoked as usual.

The houses or huts in San Antonio resemble those of Yucatan. The distinguishing feature is in the fact that the walls do not take the weight of the roof. This is supported by four or six posts numbered 1 in the diagram. On the tops of these posts rest horizontal beams, 3, which carry the whole weight of the roof. On them rest forked beams, 5; the ridge-pole is shown at 7; cross-beams at 8. The partitions are flimsy and there is no true sex segregation. The women visitors usually foregather in the kitchen, the men in the living room. The furniture is practically nonexistent, aside from hammocks.

EACH of the important Maya villages has its alcalde (mayor). A new alcalde is elected each January. Names of candidates are proposed by the older men and the voting is carried on by a show of hands, any male over 17 being free to vote. The alcalde is paid a salary of four dollars a month and is responsible for the conduct of the village. He must furnish men for any task that the district magistrate at Punta Gorda may detail.

The alcalde also acts as local magistrate, all cases of crime or misconduct being brought before him. He has the power to impose fines up to 25 dollars or prison sentences of not more than [illegible] trate. All serious cases that cannot be dealt with adequately by the alcalde's range of punishment are also referred to Punta Gorda. The alcalde is assisted in his duties by a segundo-alcalde (vice mayor) and eight policemen. The police are paid no regular salary but are paid 25 cents for every arrest that leads to a conviction.

OTHER areas are dealt with at length in Mr. Thompson's fascinating book. The sections relating to folk-lore are a valuable contribution to anthropology. The two Marshall Field Archeological Expeditions have helped us greatly in our understanding of the old Mayas by their studies of the peculiar habits of their direct descendants.

Right: Mr. Thompson his thirst with a piece of

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

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Nineteen-Story Arc Welded Building

THAT there is a definite trend toward the use of electric arc welding for fabricating the steel structures of large buildings is evidenced by a 19-story structure which is now being built by the Dallas Power and Light Company, Dallas, Texas. In this building practically all the fabricating, both field and shop, is being done by this noiseless process which is rapidly superseding the noisy rivet hammer. So far as we have been able to learn, this is the tallest building yet fabricated and erected by electric arc welding.

All the steel work for this nineteen story building is arc-welded

Human Bites and Infection

THE savage in his defense and attack on other men was seldom provided with weapons or with the science of attack and defense. Hence he scratched, tore, bit, or otherwise availed himself of the weapons of the human body.

Rat-bite fever has been classified as a definite disease because the bite of the rat usually carried into the body certain organisms which produce a definite form of disease. Human bites are apparently also associated with special infections, because of the bacteria commonly found around the teeth.

Drs. M. L. Mason and S. L. Koch have summarized a number of cases of human bites, showing that the organisms usually involved in infections which follow such bites are the streptococcus, spirilla, particularly those of Vincent's angina, and the organism of syphilis. A bite on the hand is particularly serious because infections of the hands are notoriously crippling and likely to spread. The infection is usually introduced deep in the tissue through a small wound and the organisms present in the human mouth seem to have special virulence for the structures that are involved. The methods of treatment of infection of the hand involve wide opening and complete drainage with the application of antiseptic solutions and of heat.—*M. F.*

"Blackboards" in Color

THERE are very few people who would not agree that color in the schoolroom is desirable both from the standpoint of utility as well as beauty, for it is generally recognized that some colors are less tiring on the eyes than others. To meet this obvious need the American Rolling Mill Company has developed a process for making porcelain enameled "blackboards" in colors. Some of these in a light shade of green have already been installed in schoolrooms, but they may be obtained in brown, blue, or any other color or shade of color the architect desires.

To insure a smooth, flawless finish, Armco ingot iron special enameling sheets are used as the base metal. The sheets are placed in a press and the sides and ends are bent back one-half inch. This one-half-inch draw is then punched so that the panels may be joined together. Three coats of vitreous enamel are fused on to the pure iron base. Then the glossy surface is etched with acid to remove the glaze. When completed, the boards have a velvety surface that is free from troublesome reflections.

The actual installation of the boards is simple since they are light, easily handled, and can be installed by inexperienced workmen. First, the individual sections are bolted together to make up the desired length and backed up with insulating material to eliminate sound. Then they are lifted into place and held firmly with quarter round moulding.

Ancient Procedure for Making Damascus Blades

AN ancient formula for the manufacture of the famous Damascus steel blades has been unearthed by L. A. Marple, of Pittsburgh, Pennsylvania, and is reprinted in *Industrial and Engineering Chemistry*.

> "Let the high dignitary furnish an Ethiop of fair frame, and let him be bound down, shoulders upward, on the altar of the god Bal-Hal. Then let the master workman, having cold-hammered the blade to a smooth and thin edge, thrust it into the fire of cedar wood coals, in and out, the while reciting the prayer to the god Bal-Hal, until the steel be

One of the two German "queens of the seas", the *Bremen*, has her funnels painted. Enough paint to of the color of the red of the rising sun when he comes up over the desert toward the East; and then, with quick motion pass the same, from heel thereof to the point six times through the fleshy portion of the slave's back when it (still the sword) shall have become the color of the purple of the king. Then, if with one swing and one stroke of the master workman, it severs the head of the slave from his body, and displays no nick nor crack along the edge and the blade may be bent around the body of a man and break not, it shall be accepted as a perfect weapon."

Mr. Marple believes that modern methods of tempering steel, though less romantic, work just as well and are much more pleasant.—*A. E. B.*

Balancing Airplane Propellers

THE balance of airplane propellers is one of those things that the average person seems to take for granted, not realizing that much careful work must be done on each propeller before it is ready for use. Yet variations in density of the material will not allow the propeller to be in balance even though the outside dimensions and contour are identical in the two opposing blades. A method of balancing metal propellers developed by the Gisholt Machine Company, however, insures that any residual unbalance due to density or due to faulty workmanship will occur in a predetermined position where it may be corrected without harming the propeller efficiency or strength.

In this process, the propeller blade forging is first mounted in a special fixture carried on the chuck and steady-rest of an engine lathe. The hub end of the blade is completely finished, including the drilling of a 1⅛-inch hole about six inches deep in the center of the hub.

The blade is then mounted in a master steel hub with a master blade mounted on the opposite side of the hub. This assembly is then mounted on the balancing unit of the Gisholt Static Balancing Machine shown in the accompanying photograph. The blade forging is then ground to shape, frequent inspections being made of the pitch of the blade at the required stations. As the blade is worked to approximate size, the condition of balance of the blade about the longitudinal axis is frequently checked by the indicator of a spirit level and a weighing dial. If the blade is worked and checked for balance in this manner, all of the remaining unbalance can be taken care of by plugging the 1⅛-inch hole in the hub end of the blade.

Airplane propellers being balanced as explained in the accompanying text

Device Makes Phonograph Records at Home

A NEW device which makes it possible for anyone to make his own records in the home, has just been placed on the market by the RCA Radiola Division, according to an announcement by Mr. V. W. Collamore.

"The new home recording apparatus is part of a combination Radiola-phonograph instrument," Mr. Collamore said, "so that all three functions of the complete instrument utilize practically the same mechanism. A special switch makes it possible to record excerpts from favc
programs at the same time
set is operating."

Mr. Collamore pointed out that while the records made in the home cannot be expected to equal in quality the results of the highly developed and costly apparatus of the recording laboratories, they will find an interesting and infinite field of application as "audible snapshots." Of the many uses to which this home recording system may be put, Mr. Collamore mentioned it as a possible aid to vocal and instrumental instruction, permitting the student to detect and correct his own faults. It could also be used for the dictation of personal messages to friends and relatives with something of the personality of the speaker; for recording important family events such as baby's first efforts at speech, birthday and anniversary greetings, and the children's instrumental and vocal efforts.

A simplified microphone is used for the recording process. The speech or music picked up by the microphone is amplified, passed through the regular phonograph pick-up system and impressed on a special record. The record measures six inches in diameter and is composed of a durable cellulose material. A special chromium plated needle with a blunt head is used for the recording process and for playing back the record. The grooves in the record, of which there are 90, have been previously cut, so that it remains only for the needle to impress the electrical sound waves on the grooves. A simple four-way switch makes instantly available the phonograph, the radio, the recording system, and the playback.

A young woman uses the device with which "audible snap-shots" (phonograph records) may be made in the home on special disks

Food and Growth

THE greatest advances of the first third of the 20th Century have been in the field of nutrition. Perhaps the most significant of these advances has been the change in the point of view. Scientists formerly thought that the type of human being then existing represented the highest type possible. With the coming of our modern knowledge of nutrition, it seems likely that the application of this knowledge may present a different type of man than the one we know today.

The use of vitamin D and of irradiated ergosterol as a routine in infants will mean the absence of bow-legs as well as a better development of the long bones of the body. The proper application of our knowledge of vitamin B may mean a better functioning intestinal tract, increased appetite for good food, and thereby better growth. The application of our knowledge of vitamin A apparently will bring about increased resistance to disease. Vitamin E, which has to do with sterility, may mean better opportunity for reproduction by those capable of passing on to future generations a higher type of mind.

Our early knowledge of the vitamins concerned itself entirely with the terrible end results of complete omission of these vitamins from the diet through development of the conditions called deficiency diseases. Xerophthalmia, a form of inflammation of the eyes leading to blindness, is due to absence of vitamin A; pellagra and beriberi result from a deficiency of vitamin B; scurvy is due to the absence of vitamin C; and rickets is associated with the absence of vitamin D. Modern research is concerning itself with the effects of relative absence of these substances from the diet and the possibility of producing more healthful existences for the vast majority of people by proper feeding.

With this machine, colors may be matched with absolute precision

Such significant facts as the increased height and weight of girls and boys entering college today as compared with girls and boys of the same age 20 to 50 years ago are absolute evidence of the results that may be accomplished.

It has even been taken for granted that the brain of man as it is developed today represents the highest type of intellect conceivable. Yet Frederick Tilney, in his book "Master of Destiny," emphasizes again the fact that the brain of man today represents a great evolution forward from the brain of human kind thousands of years ago. Who can say what will be the type of man of the future?

We know today that there is no specific brain food, notwithstanding the fact that quacks and charlatans have in the past vaunted fish, celery, phosphorus, and what not, for this purpose. The magic of the past was ready to accept the belief that there were specific foods for specific substances. The science of the past doubted these superstitions and beliefs because there was no evidence to indicate the slightest basis for them. Scientific knowledge developed in the last quarter century has proved the truth of the general belief at the same time that it disproved the actual superstitions held by many people.—*M. F.*

A Machine Classifies Colors

AT a recent meeting of the Technical Association of the Pulp and Paper Industry, Professor H. H. Sheldon described to the paper makers his "coloroscope" by means of which colors can be accurately and infallibly matched. The instrument, now commercially available, is based essentially upon the ability of the now well-known photo-electric cell to differentiate light both as to color and intensity and to cause a corresponding electrical response through suitable electric circuits.

Obviously, the use of the coloroscope in the paper industry is only one of the useful applications that appear to be ready to welcome the new device. In printing, dyeing, and paint-making—in fact every industry where colors are used—the advantage of classifying colors with mathematical precision rather than depending upon the fallible human eye is extremely important.—*A. E. B.*

Bandit-Proof "Auto-Teller"

A NEW device known as the "Auto-Teller" which enables customers to make deposits and transact business direct with the teller without leaving their cars supplies a long felt want in present-day congested traffic. The inconvenience and delay of parking in restricted areas and crowded traffic, and the hazards of carrying funds to and from the bank have been eliminated by this device. Located advantageously in an outside wall along a thoroughfare, the "Auto-Teller" affords unique facilities and complete protection both to the customer and the bank. Two of these devices have been installed in windows in the rear wall of the Grand National Bank of St. Louis where their rapidly increased use is daily proving their popularity.

Designed and perfected by The J. H. Wise Company, Inc., Protection Engineers, the device is built to withstand the elements and is bandit and bullet-proof. The frame is of cast steel and the openings are enclosed with Multiplate bullet-proof glass 1⅛ inches in thickness. The glass is composed of an outer layer ¼-inch thick, a center core ¾-inch thick and an inside layer ⅛-inch thick. It is as transparent as ordinary plate glass and will withstand the fire of 45 caliber steel-jacketed bullets. For decoration the glass has an ornamental sandblasted etched border.

The center glass contains a combination speaking aperture and gun port which amplifies the voice and permits the teller and customer to converse with ease in moderate tones. Immediately under this, at counter height, is the pass tray through which money or papers are passed between teller and customer. This device is ingeniously constructed so that when it is open on the outside it is automatically closed on the inside. The entire window with fixtures is so arranged as to make it impossible for the teller to be intimidated with a gun or otherwise. There are no openings that could permit drafts or inclement weather to affect the one on the inside. These devices are patented and are of solid cast bronze, being made of merchantable bronze on the exterior and manganese bronze on the interior.

The "Auto-Teller" should prove indispensable for banks in congested areas of our larger cities, where inside or rear walls permit auto traffic. It is also adaptable for sidewalk use, particularly when payrolls can be handled on the outside of premises.

Courtesy Pittsburgh Plate Glass Company

For patron-convenience and for protection: bandit-proof bank teller's cage

Chemistry of Sauer Kraut

SAUER kraut juice, which has become popular as a beverage in recent years, is not generally thought of as a fermented drink. Making kraut is, however, essentially a fermentation process, for when the cabbage is packed down in brine, fermentation is brought about by organisms which are normally widespread and require no inoculation. These organisms are salt-tolerant. The salt added, not only improves the flavor but, what is more important, prevents malfermentations.

F. C. Blanck, of the United States Bureau of Chemistry and Soils, explained to a recent meeting of the American Chemical Society that the reducing sugars normally present in the cabbage are broken down into lactic acid with small amounts of alcohol and acetic acid. The gaseous product of this fermentation is nearly 100 percent carbon dioxide, with possible traces of hydrogen and methane. The quality of sauer kraut depends largely on the temperature at which the fermentation was conducted. The most favorable temperature was between 60 degrees and 65 degrees Fahrenheit. High temperatures favored the production of soft and pink sauer kraut. A rise in temperature of three to five degrees during the first eight days was coincident with the greatest activity of the bacteria and is believed to have been caused by bacterial action.

Sauer kraut fermentation is carried out

in the absence of air. The oxygen and necessary energy are obtained from the constituents, mostly sugars, extracted by the salt. The active organisms do not utilize the lactic acid formed, so the fermentation ends with the acid production.—*A. E. B.*

Perfume Plant

THROUGH the kindness of one of our readers of New York we learn that the photograph bearing the legend "Distilleries in a perfume factory at Grasse" (France), which was selected by the editor to illustrate the article entitled "Perfume," in our number for last August, actually was taken in a plant in Germany. The picture was obtained from an outside source and there was no apparent reason to doubt the statement written on it that the plant shown was in Grasse. In the interests of scientific accuracy we are glad to make this correction.

A Novel Air-cooled Engine

THE simplicity and lightness of the air-cooled engine are to some degree offset by the increased head resistance of the outwardly projecting cylinders. In large sizes of engine, the cylinders also impede the pilot's vision. The English Napier Company has for some time been developing a novel air-cooled engine in which these disadvantages are largely removed.

The new Napier engine has 16 cylinders [illegible] their arrangement in four blocks of four cylinders each, vertically opposed, giving an H formation, results in an engine of compact frontal dimensions and small head resistance. The engine is shown in side view in our illustration. The engine develops [illegible] horsepower and its weight is 620 pounds. This is not as low a ratio of pounds per horsepower as in many present-day air-cooled engines of the star or radial type. Nevertheless, the improvement in vision and reduction of head resistance make the new motor of real interest.—*A. K.*

Contra-Propeller

WHEN the air passes through a rotating airplane propeller its speed is increased in the direction of the flight of the airplane. At the same time the air is given a swirl, or rotational velocity.

It is therefore suggested that behind the moving propeller a fixed contra-propeller be placed, with its blades set at such an angle that the swirl of the air is removed. Such a contra-propeller is shown in the sketch.

When applied by Doctor Wagner to steamships the contra-propeller has proved valuable in increasing propeller efficiency. It might not prove as advantageous for the airplane; nevertheless, it deserves a trial.

It will be noted in the sketch that the contra-propeller does not extend all the way out. This is proper, because the swirl is greatest toward the center of the propeller.—*A. K.*

Energy from the Atmosphere

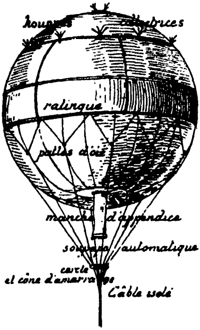
THE French are very fond of ingenious and novel devices for securing additional sources of energy. We have, for example, Doctor Georges Claude, whose recent experiments in securing energy from the differences in temperature existing at the bottom and at the surface of the sea are no doubt familiar to our readers.

Now another Frenchman, Monsieur H. de Graffigny, writing in *L'Aérophile*, suggests a new use for the captive balloon; namely, securing and utilization of atmospheric electricity.

The contra-propeller, which has been successfully applied to ships, as it would appear, from the side, if adapted for use on the airplane

Scientific experiments over a long period of years have shown quite definitely that electric potential increases as we pass from ground level to altitudes. The voltage difference between two levels a thousand yards apart is enormous, say 300,000 volts; the amperage is very much smaller but is not negligible.

M. de Graffigny states, in fact, that two French inventors working on Mont Blanc have managed to light several incandescent lamps by means of this principle. Another inventor, a Doctor S. Zildard, of Paris, has illuminated neon lamps b the same principle.



The ingenious balloon devised by the French for "collecting and utilizing atmospheric electricity." It has electric collectors and an insulated electric cable leading to earth

The suggestion is that a captive balloo would be suspended in the air, and woul be provided with rigid meta metallic electricity collectors ity collectors and the rings inter-connected and an insulated cable would bring the energy down to earth.

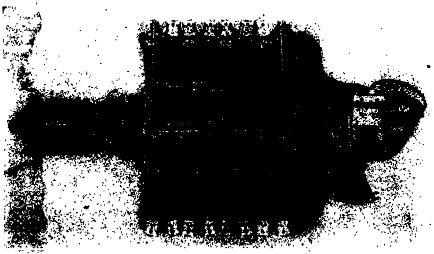
The difficulty is, of course, that we would have to utilize energy of high voltage but low current. Many other difficulties suggest themselves, such as the dangers of thunder storms, the maintenance of the balloons, and so forth. Still it would be very wrong to say that sometime in the future there would not be here another application of the captive balloon.—*A. K.*

The Fog Eye

AN architect of Huntington, Long Island, Paul Humphrey MacNeil, after many years of patient work, has developed what he calls a "fog eye," intended to lessen the dangers of either marine or airplane navigation in fog.

The principle of the apparatus is based on the fact that the infra-red rays, which are invisible to the eye, are not impeded by fog. The infra-red ray will penetrate the densest fog, impenetrable by the most powerful electric beacon. The lighthouse, lightship, or airway beacon, will be provided with a projector which will shoot out these invisible infra-red rays to aid ships or airplanes, as the case may be.

The projector will operate somewhat like a telegraph transmitter, sending the infra-red beams in dots and dashes. These dots and dashes will be picked up by a receiver in the airplane, containing a detector element similar in principle to the delicate thermo-couple used by astronomers in the measurement of the radiation of heat from the stars. The detector element is placed in a vacuum and receives the infra-red rays



Compact frontal dimensions and low head resistance are characteristics of this novel engine, one side of the "H" formation being shown in this picture

through a window of fluorite, the energy of the rays being converted into heat when striking the detector.

Combined with the detector are amplifying relays, automatic signal devices, and recording instruments, which give both a visible and audible record of the signals to the pilot. In a test of the invention at Roosevelt Field, Long Island, recently, the infra-red ray was effective through a mile and a half of fog bank that had held the pilots completely in check.

There is no doubt that the "fog eye" is another and highly useful method of attack on the problem of fog or blind flying.—*A. K.*

Safety Belt Strength

THE strength of a safety belt should be amply sufficient to prevent the passenger from being thrown from his seat, either in rough maneuvers in the air or on a bad landing. At the same time, the concentration of stress that a safety belt can impose on a man's body may itself be a source of danger.

The best safety belt would be one which, adequately strong, would yet distribute the load over a large part of a man's body. It is to be hoped that some new type of safety belt will be devised to meet these require-

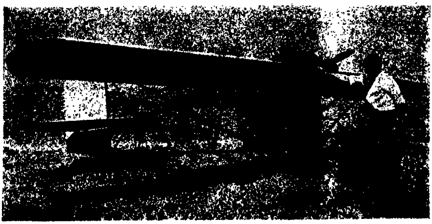
It is interesting to note how strong present-day safety belts are: According to the Bureau of Standards, the limits of strength are between 700 and 1200 pounds.—*A. K.*

Ground Training for Gliding

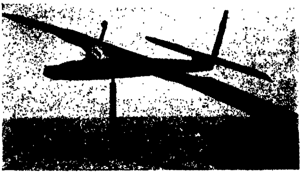
THE one drawback in glider training is that the actual time which the elementary student spends in the air is very brief. The duration of a glide may not exceed 20 seconds and a student therefore has very little time to familiarize himself with the action of the controls.

A number of methods have been proposed for "ground glider training." Two of them are shown in our illustrations. In one, a full sized glider, with a student in it, is mounted on a universal or ball and socket joint on top of a tower some ten or twelve feet in height. The glider, exposed to the gusts of the wind, sways in all directions, and the student has a lovely time trying to keep it pointing in one direction and on an even keel by the use of the ordinary glider controls. The student certainly ought to learn a great deal from the process. This type of training has been invented by Paul Chamberlain of Los Angeles.

Even in training for powered flight, it is possible that some form of artificial "ground flight training" may be helpful. Two men, H. S. Myers and P. D. Smith, also of Los Angeles, have designed a power glider which they call the "Cycloplane" which has enough power to do many maneuvers on the ground, but which cannot leave the ground. Seated in the "Cycloplane" the student can do a great deal of pitching, make a turn on one wheel and can otherwise get the hang of things very readily. This may be of some real help when actual flight training is begun.—*A. K.*



Above: The Cycloplane in which the student can do a number of glider maneuvers without leaving the ground.



At right: The ground glider, invented by a Los Angeles man, which has the controls of a regulation glider or sailplane.

Some Data on Parachutes

IF a man is thrown overboard from an airplane, how fast will he fall? The man in the street answering such a question would probably set down an impossibly high figure. As a matter of fact, the Army Air Corps, among other organizations, has tested the speed of a falling dummy, simulating a man, and has discovered that such a dummy, weighing about 180 pounds and the size of a man, with a dummy parachute packed on his back, will attain a speed of only 119 miles per hour after falling some 1200 feet in 11 seconds.

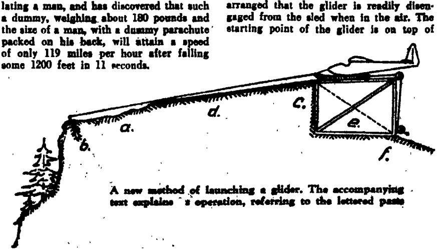
The main importance of tests on the speed of a falling body lies in the light that it sheds on manually controlled parachutes. Airmen who are open to the possibility of jumping for life are interested in the lowest altitude for a safe leap. A parachute, such as the Irving 'chute, opens, on an average, in 1/5 to 3/5 of a second. If we assume that a man may fall a second before pulling the ring, then the above data would indicate a hundred feet as the minimum altitude lost before the 'chute would open. One member of the "Caterpillar Club" escaped at 150 feet, and several pilots have leaped safely from their planes at 200 feet above the ground. It is interesting to read in *Aircraft Engineer* that English and American experts conducting experiments independently have arrived at the same conclusion.—*A. K.*

A New Method for Glider Launching

NO one takes gliding as seriously and energetically as the Germans, and they tinually announcing interesting little wrinkles. The appended sketch, which we owe to the courtesy of *Flugsport*, illustrates an ingenious method of improving the launching process.

Referring to this sketch, the plank *d*, about 12 yards long, is carefully soaked or covered with oil so as to lessen friction. The glider is mounted on a starting sled so as to lessen the strains imposed on the glider itself.

At the front end of the starting sled there is attached a long rubber cord of either two or three strands. This rubber cord is anchored down in the ground at the point *b*, and the glider is connected with the sled through a short wire and a starting hook so arranged that the glider is readily disengaged from the sled when in the air. The starting point of the glider is on top of



A new method of launching a glider. The accompanying text explains its operation, referring to the lettered parts

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the hangar *e*. The glider, mounted on the sled, is carefully drawn back as far as possible by turning the shaft and handle *f*; at the same time the cords *a* are put under considerable tension. When the handle *f* is released, the tension of the cords pulls the glider down the incline and launches it speedily into the air. To prevent the sled itself from going overboard, there is a gentle brake on the shaft which comes into action when the sled approaches the end of the runway.

It is quite obvious that a mechanism of this description will facilitate gliding take-offs and make life easier for the persevering glider enthusiast.—*A. K.*

Inflating the Metal-clad Airship

WE have had occasion to describe fully the construction of the first successful metal-clad airship the *ZMC-2* which is now being successfully used in service by the Naval Air Station at Lakehurst, New Jersey. The process of inflation of such an airship is a matter that calls for careful technique.

It is very difficult to separate helium from air, so the original inflation was carried out in two stages. In the first stage, carbon dioxide displaced the air in the ship. The carbon dioxide was introduced at the bottom and the air forced out at the top of the hull. In the second stage the process was reversed. The lighter helium was led in at the top while the heavy carbon dioxide was forced out the bottom of the hull.

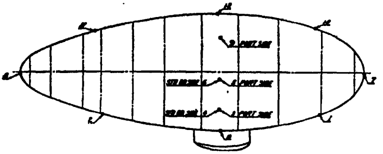
When ready for inflation, the hull was suspended in the hangar with everything

...e hangar. These cylinders were attached by means of two "octopus" manifolds to a six-inch pipe line allowing 16 cylinders to be discharged into the pipe line at the same time. The six-inch pipe ran the entire length of the ship and was tapped at three points by lines which led to the bottom of the hull. The carbon dioxide was forced into the bottom of the hull at about 10,000 cubic feet per hour. The displaced air was exhausted from the top of the hull to the outside of the hangar through other connections.

The helium inflation was of a similar character. The helium was run in at 10,000 cubic feet per hour. Unfortunately some of the helium was mixed with the carbon dioxide; therefore a scrubber was used to separate the helium from the carbon dioxide in the exhausts. In the scrubber a caustic solution absorbed the carbon dioxide, and the pure helium was returned to the hull.

Since no drier was used, the helium gas in the hull contained considerable water vapor. Some of this vapor was condensed and drained from the hull. Subsequently a drier was set up and a blower forced helium into the drier, caused it to travel through the apparatus and return to the hull. The drier was simply the caustic soda scrubber rebuilt.

A number of sampling tubes as shown in the sketch were placed at various points of the airship. It was found on test that the helium was 92 percent pure in the airship and that the carbon dioxide was reduced to negligible proportion.



Position of gas sampling tubes on the hull of the metal-clad airship

One feature of the metal-clad airship is reduction in the loss of helium. Only 100 cubic feet are added every 24 hours to replace leakage from the hull. In the fabric airship the air leaks inwardly, but in the metal-clad there is no inward leakage of air. This gives the metal-clad airship a decided advantage over the fabric ship since the purity of the helium is thus left intact after service.—*A. K.*

Latest Army Observation Plane

TESTS of the *XO-1G*, the latest Curtiss military observation plane, have been completed by the experimental division of the Curtiss Aeroplane and Motor Company at the Garden City plant and the plane delivered to the United States Army Air Corps.

This plane is powered with a water-cooled Curtiss D-12 engine developing 425 horsepower, and showed a speed, in preliminary tests, of 147 miles per hour which is considerably faster than other types of observation planes with equivalent power.

venience are made possible by several changes in design such as a landing gear streamlined with "pants" for reducing wind resistance and increasing ease of handling on the ground. The wheels are located farther back than on other designs; the landing gear is shorter, tending to eliminate ground loops. A 12-inch pneumatic tail wheel has been located well back and the landing gear struts have been constructed to lessen side motion when shock absorbers begin action, thereby reducing the aerodynamic interference between struts; consequently the drag is less. Parking brakes are provided and the tail skid is steerable.

Six degrees down-vision over the nose is provided.

An upper wing cutout eliminates air draft on the pilot. The gunner's compartment has been improved with two alternate gun mounts and a new type of gun mount which eliminates the various disadvantages of the old scarf ring and the newer arm type as well. Less wind resistance, saving of weight, larger arc of travel and ease of operation to eliminate awkward positions when firing over the side are features of this mount. When not in use, this new gun mount drops partly into the cowl.

The metal-clad airship in the hangar where it was built. Its metal "ribbon" construction is shown

To give the rear gunner more freedom of movement, the rear cockpit has been en-

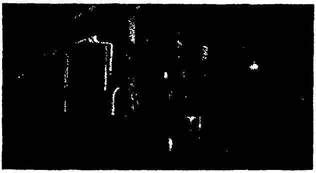
...es on rollers, and can

...vard part of the cockpit, entirely out of the way. It is so arranged as to allow the gunner to sit on it com-

(*Please turn to page 57*)

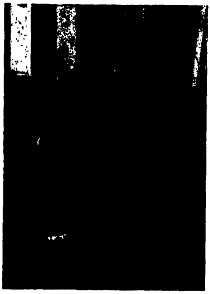
The Army's latest observation plane is beautifully designed

Rotary conditioner, cooler and mixer



Continuous apron heat-treating machine, where temperatures range from 160° F. upwards to 300° F. and over. 10,000 pounds a day

Where tobacco is mixed hot or cold, dry or moist. Capacity 50,000 pounds a day



Where rum is sprayed on the cool tobacco

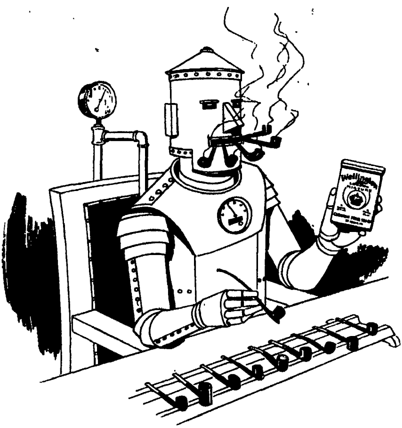
MIXING AND BLENDING TOBACCO

IN the magnificent new Missouri State Capitol building, overlooking the banks of the Missouri River, is the interesting H. L. George collection of relics. One of these exhibits contains the following inscription:

"The natives of North America held tobacco in sacred regard. They made smoke offerings, accompanied by invocations to their Deities and Spirits; treated disease with tobacco; offered it in propitiation of angry waters; to allay destructive winds; to protect the traveler; to ward off danger; to bring good fortune. Tobacco was cultivated in most tribes by men alone, and usually smoked by them only. It was dried carefully, and kept as free from moisture as possible. That intended for immediate use was hung in bags of birch bark, deer skin, or skins of other animals, or in baskets."

Taken literally it seems just ignorant superstition, doesn't it? But, maybe behind it all, was the appreciation by those old Indians of that peculiar virtue in tobacco, of giving pleasure under all circumstances. The Indians evidently valued it as their choicest treasure—sort of a cure for all ills, even though used in its crudest form. What an even greater treasure is Wellington, the perfect blended tobacco, with seventy-eight years of study and experience behind it. That's how old the Christian Peper Tobacco Company is, having been established in 1852, at which time tobacco was dried only on nice sunny days on the roof, and the flavor was cooked in the kitchen at home. The business is now in the hands of the third generation.

"Tobacco smokers little realize what a difference there is between a mixed tobacco and a blended tobacco. They can't, because they have no opportunity of making comparison on exactly the same leaf," says Mr. Elmer C. Peper, President of the Christian Peper Tobacco Co. "Take Wellington", Mr. Peper continues. "The selection of the seven different tobaccos, and their proper quantities, was the result of seventy-eight years' experience in the tobacco business. Given these seven tobaccos, one might say it would be an easy matter to mix them. It is, if you mix them. It isn't, if you blend them. Each one of the seven goes through a different process in order to bring out the quality for which it was selected. The nature, time, heat and moisture of each process is different. Some of these tobaccos are mixed warm, some cold, some wet and some dry. Each one is added at a particular stage of the blending. Such a little thing, for instance, as the direction of the wind, makes a difference in our treatment. Sounds funny, perhaps, but the direction of the wind affects the temperature, as well as the draft and moisture in our factories. It is thus only by the exercise of extreme care, in every detail, that the best of the flavors of the seven kinds of tobacco can be refined and blended into a smoke whose composite natural flavor is most unusual.



We'll "Break In" Your Pipe--*Free!*

WOULDN'T you like to smoke a pipe without the exasperation of "breaking it in"? Now you can! We'll gladly have the world's sweetest cake and flavor mechanically smoked into any briar pipe you send to us. And then return it promptly ...without cost!

Only real, honest-to-goodness tobacco will be used to fill your pipe. You have your choice of Wellington London Mixture, or English Walnut, the newest thing in cigarette and pipe tobacco. You'll be surprised to find how smooth and sweet either brand will make and keep your from-then-on favorite pipe. So if you are "breaking in" a new pipe now, or have one not fully broken in, just mail to us and let our experts complete the job.

Please make sure that your pipe is wrapped well enough to be safe from damage. Enclose return postage. Print your name and address on the outside of package. Also which brand is preferred, "English Walnut" or "Wellington". Address Christian Peper Tobacco Co., 711 N. 1st., St. Louis, Mo. It is wise to insure package.

Special Xmas Gift Offer. One pound tin Wellington London Mixture for $1.50, postage prepaid to any address in the United States

WELLINGTON

Made by CHRISTIAN PEPER TOBACCO CO., St. Louis, Mo.

"To get the full benefit of them some thought should be given to the care and the use of your pipe. We had no idea there was as much to pipe smoking as there is until we talked to a confirmed old pipe lover. This is what he said.

"'Is there anything as good as smoking a good tobacco in a good pipe? If there is, I haven't found it. First of all you must have a good tobacco, like Wellington, for instance. Second, you must know how to smoke your pipe. A real pipe smoker always has six or seven tried and trusty pipes. He never smokes one when the stem and bowl has become foul. Every once in a while he uses alcohol to give the pipe a thorough cleaning out, but he does not allow it to stand in the pipe. If you will exercise this care and use Wellington, you will get increased pleasure from pipe smoking.'"

Pipes are made out of rather interesting materials. A few of the best are—

Amber, generally used for mouth pieces, sometimes for the bowl, is a mineralized vegetable matter. Amber is used because of its attractiveness and the faint odor given off when heated. Amber, however, is more or less easily broken.

Meerschaum, "foam-of-the-sea" is a rare peculiar clay. The desirability of this clay as a pipe material arises from the fact that it absorbs some of the smoke, and when treated with wax, turns a beautiful color.

The use of the popular Missouri corn cob pipe has extended all over the world. It is made from a certain species of corn which has an extremely large cob, and is grown with the best success in Missouri. Corn cobs have absorptive qualities, too.

Briar is the most popular material of all. It combines most of the good qualities of the other materials and at the same time will stand more abuse. Briar is the root of a heather grown in the high regions of Southern Europe. The most desirable roots are one hundred years or more in developing. For this reason, with the increasing popularity of pipes, these roots are becoming rare and no doubt will some day practically disappear from the market. Many other woods are used, such as apple, pear, maple, laurel, etc., many of them made to imitate Briar, but none of them are as satisfactory as the original briar from Southern Europe.

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 56)

fortably whether he is facing forward or toward the rear.

The horizontal tail surfaces of the airplane are very efficient. The Handley-Page type balance is used on the elevators. Without any load whatever in the rear cockpit, it is possible to land the airplane without rolling the stabilizer all the way back. With full military load, the ship still trims very easily with the stabilizer, and retains longitudinal stability power-on and power-off.

The pilot's seat is given more vertical travel and the inclination of the seat back is greater to make it more comfortable for taller and larger men. A changed front gun installation allows all instruments to be grouped on one board, which follows army design as closely as possible. The center section is indirectly lighted and the instrument board is covered with a crash pad—2½ inches thick of sponge rubber—with holes cut through to see the instruments.

Miscellaneous installation features include a ball-bearing control stick designed to eliminate service troubles, an ammunition box removable for filling and easily handled, a small baggage compartment on the left side of the ship directly ahead of the instrument board, and a large canvas baggage compartment in the camera bay which can be used when neither the gun, camera, nor radio are carried and which folds out of the way otherwise. The stabilizer may be adjusted from either cockpit.

A cutout in the trailing edge of the upper wing reduces the backwash on the observer's cockpit, benefits the vision and decreases the aerodynamic interference between the upper wing and the front cockpit windshield. Thus, the air flow from the propeller is not forced through a small opening and wind resistance is reduced.

The Stenode Radiostat

IN the article entitled "Television Needs New Ideas—and Less Ballyhoo" by A. Dinsdale, which appeared in our November, 1930 issue, mention was made of the Stenode Radiostat system invented by Dr. J. Robinson of England. Since the publication of this article much interest has been expressed in the receiver and we have been asked for constructional details. As yet they are not available.

Essentially the Stenode Radiostat receiver consists of a superheterodyne of conventional design with the exception of the second detector circuit. Here is incorporated a Piezo crystal and a series of capacities in a bridge circuit. By means of this particular arrangement, Dr. Robinson has been able to increase the selectivity to a point heretofore thought impossible.

In a demonstration held in the Engineers' Society Building in New York City, the other day, the writer witnessed a test of a Stenode Radiostat receiver in comparison with a standard superheterodyne. A small transmitter had been set up at one end of the demonstration hall and had been

(*Please turn to page* 60)

How you can retire on

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"That can be taken care of. The income can be made to continue as long as either you or your wife lives."

"Suppose I should be killed suddenly by some accidental means."

"Your wife would receive double the amount of cash or double the income received in the event of natural death."

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It guarantees upon death from accidental means before age 60

A Cash Payment to your beneficiary of $40,000. Or a monthly income for life.

It guarantees in event of permanent total disability before age 60

A Monthly Income of $200. Plans for women or for retirement at age 55 or 65 are also available.

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THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

IN the November number we published brief descriptions of five telescopes made by average beginners This time our space is devoted to a description of a large instrument such as more experienced amateurs may expect to make as their second or third job The description comes from A. V Goddard, 282 Northeast 49 Street, Portland, Oregon

"Although I have almost learned the SCIENTIFIC AMERICAN s instruction book 'Amateur Telescope Making by heart and have recommended it to many others," says Mr Goddard, "I must admit that I bought my mirror It was made by John Mellish of St Charles Illinois, the same person who figured the 30-inch for the University of Illinois

"I began about 20 years ago experimenting on mirrors liquid objectives—that is filling the space between two ground surfaces with silicate of soda—and buying small inexpensive telescopes and objectives making an extension on my tube I became rather discouraged with my mirrors because I would try them once, obtaining a good image, then the next time they would be distorted I did not know at that time that the temperature was affecting my glass I finally decided on a mirror made by someone who knew how, hence the 16 inch I found out afterward that I was bothered just as much by temperature with the new glass, until I learned to give it time to cool and then later to use a fan [explained below Ed]

"As for results on the 16 inch I have seen seven satellites of Saturn and of course all of the rings At very rare intervals I have seen the companion of Sirius and also the companion of Antares The climate here at Portland is not good enough for much power and I use a one inch eyepiece more than any other However, I have been able to use up to 640 diameters magnification quite successfully I can see the surface markings in the lunar crater Plato quite clearly when the light is right

"The small refractor in the photograph is a four inch Gall and Lembke with a John Berni objective It is very good and I use it mostly on the sun It comes in handy to have an extra glass when a class or group of people come

"The tube and mounting of the 16 inch weigh about 750 pounds, so I have a ball thrust bearing around the two inch shaft of the polar axis This also makes the R A motion very steady The concrete base is 20 feet in diameter and two feet thick in the center around the 12-inch pillar (I wheeled all the concrete, too, a sidelight on astronomy). The pillar is solid concrete with a six inch pipe set in the top and a six inch cast iron 45 degree ell [illegible] on to the pipe. I am fortunate in that Portland is on the 45th meridian and the ell was just right

"The declination axis is a two inch cold rolled shaft set in boxes on a steel plate which has been welded to a heavy collar set on the end of the polar axis The circles are cast brass disks ten inches in diameter, with the hours and degrees ruled on the perimeters The divisions are down respectively, to four minutes and three degrees which are in turn divided on the verniers

The tube is heavy gage galvanized iron and is 17 inches in diameter and 128 inches long The finder is a two inch glass with cross hairs. I plan to have an observatory later The dome will be 20 feet in diameter"

Mr. Goddard and his two telescopes

IN his letter, just quoted Mr Goddard referred to a fan The use of an ordinary electric fan for maintaining a circulation of air through the tube of a telescope was mentioned on page 405 of our number for last May All astronomers, professional and amateur know that star twinkling, unsteadiness of image, 'boiling," and sundry other optical nuisances are caused by atmospheric conditions, mainly the irregular distribution of temperature in the air, which produces differential refractive effects, and that a night with misty hazy air usually will provide better seeing than a still, sharp night in which the stars stand out against a crystal clear sky It usually is assumed that the whole of this effect takes place aloft but some workers have questioned whether half of it, at least, is not caused actually *within the tube of the telescope itself* Here, too, there often are temperature effects, due no doubt to the stratification of air in the tube. Accordingly, last May, it was suggested that *open sided*—that is latticed—tubes might prove to be superior to the type of tube made of solid sheet metal or wood

Bearing on this point Mr Goddard adds the following comment to his letter "I have the 16-inch reflector but as yet no observatory, and I found the open or latticed variety of tube was unsatisfactory in my case because of the interference of street lights so I finally settled on the present closed tube with an open door just above the large mirror This worked better but often I would have to wait an hour or more for the mirror temperature to settle I read of some experiments by Professor W H Pickering with a fan so I decided to give it a trial

'I purchased a small six inch electric fan and attached it direct to the tube so it would blow in through the door But the slight vibration of the fan was so magnified in the eye piece that the idea seemed impracticable I then secured the standard for a music rack and made a separate mounting for my fan, also in order that I could raise it or lower it and set it at any angle When I first tried it, a friend who was not accustomed to looking through a telescope happened to be calling, so I asked him to look at Jupiter Only about three of Jupiter s belts were visible—until I turned on the fan Then he said, 'Why that makes a *great* difference I can see 100 percent better'

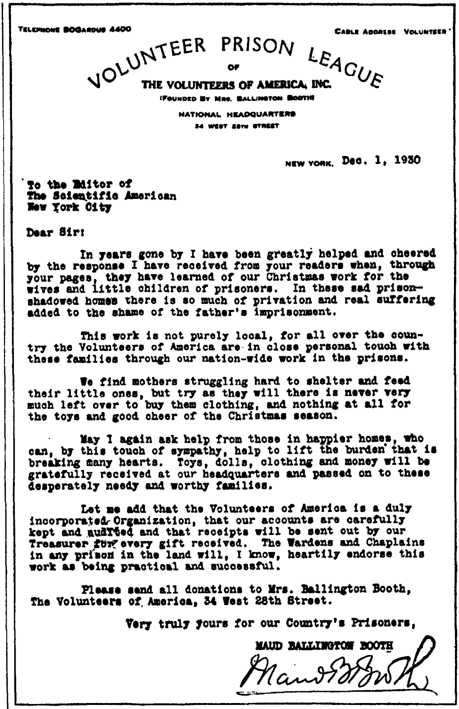
"The effect was like blowing away a fog and the detail even with 600 diameters was very clear Since then I have found the fan so far ahead of any other method that I always use it"

WHAT was it that Professor Pickering said about the use of a fan in the article Mr Goddard read? We quote it from *Popular Astronomy* for last March where it was published 'We all know when first starting a furnace in the autumn that the hot air does not at once pour out of the flue but is for a time blocked by the cold air already there, and which floats on top of the hotter lighter medium later gradually mixing with it, and finally being forced out into the room If we could look through those mixing masses of air in the flue, we should find the seeing intolerable It occurred to me while using my reflector that that was just what was occurring within the iron tube of my telescope When the shelter is rolled away, and the instrument is exposed to the outside air, the upper end of the tube is cooled by radiation to the sky, while the lower end, not so completely exposed, retains some of its original warmth We accordingly have within the tube a mass of cold air resting upon a mass of warmer material. Since the quality of the seeing is not influenced by the velocity of the air currents, whether within the tube or in the sky, no matter how high that velocity may be, but is strongly influenced by the least difference of temperature, I determined to go to the bottom of the matter and collect the fundamental facts."

PROFESSOR Pickering next describes experiments he made, ascertaining actual temperatures in various parts of the tube, and in the surrounding air, by means of thermometers, and concludes: "The obvious remedy to employ is to use an electric fan, forcing a current of air from the window near the mirror up through the tube. Care must be taken to support the fan in such a manner that it shall not jar the telescope. A six-inch fan is plenty large enough. With poor seeing, due mainly to currents in the upper air, the improvement resulting is not marked, but with good seeing it is most striking. It is very nicely illustrated by throwing a bright star out of focus before turning on the fan. The image usually rotates, sometimes in one direction, sometimes in the other. The rings always visible in such an image constantly vary in shape, with an appearance that we may describe as 'moulding.' The instant the fan is turned on all is instantly changed, the rings become circular, and all rotation ceases. Mr. Phillips in a recent paper (*Journ. Brit. Astron. Assoc.*, 1929, 39, 113) speaks of having tried an 'electric blower' but does not seem to have been quite satisfied with the result, because trouble began 'as soon as the blower is stopped.' In my original paper (Report on Mars, No. 41 *Popular Astronomy*, 1928, 451) describing the use of a fan, I state that an 'electric fan sending a current of air through the window near the mirror, and up through the tube, was later found to give greatly improved results.' It did not at that time seem necessary to me to state that the fan should be kept going. In order to avoid jar I always support it on a cushion.

"Since the opinions as to the relative advantages of open versus closed tubes are so divergent, it appears to me likely that with neither form are the mixing air masses entirely avoided, and that each observer should settle which is the best form for his own individual case. However, when an electric current is available, I feel that a closed tube with a fan entirely avoids the whole difficulty, and is therefore better than any open tube can be."

WHETHER to use the conventional closed tube, a latticed tube, or a closed tube with a fan driving air through an opening near the base ought, it would seem, be determinable once and for all by a simple experiment. The case is not, however, that simple—not by a long shot. No two telescopes, no two situations, no two nights are alike, and therefore the decision will not easily be arrived at in many instances. At least, no opinion ought to be formed until, like Mr. Goddard, the user has observed conditions over quite a period of time. Workers who have formed opinions are invited to submit them for publication, for the benefit of others. Some have had trouble with the latticed tube due to dewing of the mirror. Sometimes this may be remedied by wrapping the lower part of the tube with cloth—or making it solid in the first place.



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NEW YORK. Dec. 1, 1930

To the Editor of
The Scientific American
New York City

Dear Sir:

In years gone by I have been greatly helped and cheered by the response I have received from your readers when, through your pages, they have learned of our Christmas work for the wives and little children of prisoners. In these sad prison-shadowed homes there is so much of privation and real suffering added to the shame of the father's imprisonment.

This work is not purely local, for all over the country the Volunteers of America are in close personal touch with these families through our nation-wide work in the prisons.

We find mothers struggling hard to shelter and feed their little ones, but try as they will there is never very much left over to buy them clothing, and nothing at all for the toys and good cheer of the Christmas season.

May I again ask help from those in happier homes, who can, by this touch of sympathy, help to lift the burden that is breaking many hearts. Toys, dolls, clothing and money will be gratefully received at our headquarters and passed on to these desperately needy and worthy families.

Let me add that the Volunteers of America is a duly incorporated Organization, that our accounts are carefully kept and audited and that receipts will be sent out by our Treasurer for every gift received. The Wardens and Chaplains in any prison in the land will, I know, heartily endorse this work as being practical and successful.

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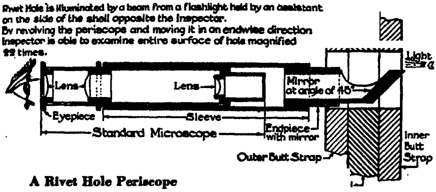
THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 57)

tuned to emit a wave about two kilocycles away from that of a local station. The local station was tuned in on the standard superheterodyne but reception was completely spoiled by the interference from the transmitter in the room. Then the same local station was tuned in on the Stenode Radiostat and even though the transmitter in the room was operating at a frequency only two kilocycles from that to which the Stenode Radiostat was tuned, it was impossible to detect any interference whatsoever.

Apparently Dr. Robinson's system holds great promise for the future. However, it is not as yet available in commercial form.—*A.P.P.*


Rivet Hole is illuminated by a beam from a flashlight held by an assistant on the side of the shell opposite the inspector.
By revolving the periscope and moving it in an endwise direction inspector is able to examine entire surface of hole magnified 22 times.
Light
Lens
Lens
Mirror at angle of 45°
Eyepiece
Sleeve
Standard Microscope
Endpiece with mirror
Inner Butt Strap
Outer Butt Strap

The sketch above shows a cross-section of the new periscope for examining rivet holes, and the notes explain its operation. *At right:* Method of using periscope in a large boiler

A Rivet Hole Periscope

FOR decades engineers have been studying the serious "ailment" known as "caustic embrittlement" which affects steam boilers, causes cracking of the metal around the rivet holes, and often causes disastrous explosions. Much light has been shed on the subject but there is still much to learn since experience with various kinds of feed waters leads to a number of what appear to be contradictory conclusions.

The accompanying illustrations show the ingenious Hartford Rivet Hole Periscope designed by Assistant Chief Engineer Morrison of the Hartford Steam Boiler Inspection and Insurance Company. This instrument has proved of great value on many occasions and is one of the means whereby early discovery of caustic action has been made possible. Cracks so small that they are invisible to the unaided eye are magnified 22 times by the reflecting mirror and lens, and no matter how deep the hole, the instrument permits a minute examination of its walls. Its ingenious construction is shown by the sectional drawing.

Kill Ferocious Fish With Electric Device

A CANNIBALISTIC fish killer with a snake-like body, known as the gar, is being eliminated in southern waters by electricity, according to J. G. Burr, research director of the Texas game, fish, and oyster commission.

The gar-killer consists of a barge with a seine attached to one end. Wires that run throughout the seine are charged with electricity by a specially built generator. A 200-watt spotlight plays upon the water, and the gars which swim close to the surface are blinded, caught in the net, and stunned by the electric current. The hapless gar sinks to the bottom and suffocates, while other fish, which may have been stunned, float to the surface and soon recover.

"Ridding the waters of gars would mean the saving of millions of fish each year," Mr. Burr says.

Soap from Sulfur Smell

SULFUR smell in coal gas has been converted into medicinal soap at Ohio State University. Results of one year's experiments with this soap were recently reported to the medical section of the American Chemical Society by Dr. Emery R. Hayhurst, professor of hygiene at Ohio State University. He said the soap is made from a new form of sulfur which was discovered some time ago while removing sulfur and other impurities from coal gas.

The sulfur resembles moderately wet clay. It differs from other sulfurs in that it is composed of finer particles, all of them under ten thousandths of an inch in diameter. Twenty percent of this new sulfur was mixed with castile soap and perfumed.

Dr. Hayhurst said he tried this soap on members of his own family and the families of some of his scientific friends with no harmful results. It was then tried upon a wide variety of persons, from babies to machinists, and on different types of complexions. It was found to be free from damaging effects to scalp, hair, or nails, and did not sensitize the skin.

"Its effects are remarkable," said Dr. Hayhurst, "in practically all cases encountered of simpler chronic skin diseases like eczema, acne, and facial blemishes." Three manufacturers of plated materials told the professor that the gas soap appeared to cure platers' rash, and one concern reported that after a saige of mechanics' boils, lasting over five years, the gas soap eradicated them within three months.—*A. E. B.*

Rabies Treatment for Drug Addicts

FREQUENT dog-bite cases from an Egyptian village led to the discovery that the villagers, addicted to narcotics, were resorting to subterfuge to gain access to a rabies hospital in Cairo, where they believed the treatment would cure their craving for heroin, according to a report made public by the Department of State.

The doctor in charge of the Cairo Antirabic Institute noticed a curious frequency of dog-bite cases from a particular village in lower Egypt. Usually in a large proportion of patients bitten by a reputed mad dog, the dog is eventually killed and sent up for examination. He observed that although these cases all came from the same village, in no case was there any record of the dog. He, therefore, had his suspicions and finally put one of the patients through a very close cross-examination with, as a result, the following admission:

"I and the rest of us who have come up here for treatment for rabies have actually never been bitten by a dog. We are all dope addicts. We are ruined men with no hope. We have lost everything and there is no one to help us or cure us of our addiction. Some months ago, one of our villagers named Mohamed, who was a hopeless drug addict, happened to be bitten by a mad dog; he was sent up here for treatment for rabies and was eventually sent back to our village, cured not only of the rabies but also of his desire for dope. When we saw this we marveled and said, 'Here is a way of being cured of our heroin addiction. But how are we to get to this Cairo hospital?'

"We thought it over and in the end went to the village barber who, as you know, is the Government sanitary agent, and we said to him: 'O barber, we want to go to the mad dog place in Cairo as they will cure us of drug addiction. But how are we to get *there?*' So the barber thought for a time and then said: 'Come back again in a week.' A week later we went back and the barber explained to us that to get to the Cairo hospital we must seem to have been bitten by a dog so as to get a certificate from the local public health doctor.

"He then showed us how he had got the jaws of a dead dog and had fitted the jaws with a steel spring and explained to us that with this machine he would give us the necessary lacerations to simulate the bite of a live dog. We, therefore, each of us, at reasonable intervals, were bitten in the leg, or elsewhere, by the barber's 'dog,' submitted ourselves to the public health doctor and got sent up here to the hospital where we are sure we shall be cured of our desire for dope."

Comic perhaps, but pathetic to a degree. It would at the same time be of interest to know whether the Pasteur treatment may not possibly have some effect on narcotic addiction.—*The United States Daily.*

No Skeleton Key Can Open This Door

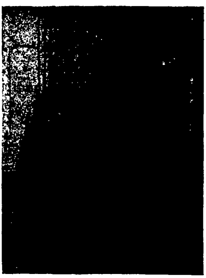
THOSE who depend upon skeleton keys and such paraphernalia to open resisting doors will find such instruments of no avail at one of the rooms of the Vacuum Tube Engineering Department of the General Electric Company at Schenectady. The door of that room opens only at the touch of the finger—and only at a particular touch. If you don't know the formula or code, if you haven't the "open, sesame," you can't enter.

Such a door at the outer portal of a lodge room would guarantee the exclusion of all but the initiated. The guard at the outer gate is no longer necessary. Knock correctly and the door swings open, and you see the "welcome" on the mat. You do not have to depend on the judgment or bouncing power of a doorman.

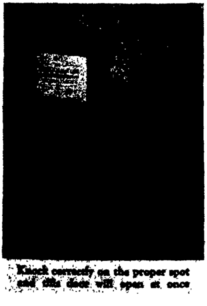
This demonstration of the magical properties of electricity is an application of the newest tube development of the General Electric research laboratory. The thyratron, as the tube is called, directly controls large amounts of power; an input of a fraction of a watt is sufficient for the typical thyratron to "turn on" a kilowatt.

At the right of the laboratory door there is a metal plate. The plate has a fixed electrical capacity. When this fixed capacity is unbalanced by the application of variable capacity, such as tapping by a person's hand, a series of four thyratrons on the inside of the room is set into operation, each with a particular duty in an intricate electrical circuit. The final thyratron operates a relay which releases a lock and starts a motor on the hydraulic door-opener. The circuit may be set for any sequence of contacts or touches, and will respond only to the sequence for which it is set.

If "52" is the secret code, for example, the metal plate is tapped lightly five times, followed by a pause of a few seconds, and then tapped twice. The thyratrons then function, and the door swings open.



The mechanism that causes a door to swing open to a secret code knock



Knock correctly on the proper spot and this door will open at once

Athlete's Foot

ATHLETE'S foot has come to be a commonly known condition because of the extensively advertised preparations for its relief. This condition is a form of ringworm, and it is not surprising that specialists in diseases of the skin are beginning to report cases of extension of the condition to the hands and to other portions of the body. Organisms responsible for the disease are transferred from the feet to the hands and by means of the hands to other portions of the body, such as the inner side of the thighs and the buttocks, which provide conditions particularly suitable to growth and multiplication. When the condition occurs on the hands there are oval spots slightly inflamed, with scales. The organisms can be found in these spots when scrapings are made and studied under the microscope. Some people are apparently more sensitive to this type of infection than are others, and investigations show that there may be special sensitivity of the type called allergic or anaphylactic.

Dry Powder Extinguishes Fires

A NEW form of fire extinguisher which utilizes a dry chemical, expelled in a cloud by nitrogen or carbon dioxide, has been developed. The method briefly consists in blowing a dry, powdered chemical, which gives off carbon dioxide when heated, through a hose and controlled nozzle by means of an inert gas.

In the hand extinguisher, the inert gas is carbon dioxide, which is contained under pressure in the extinguisher body. In the larger sizes, a separate cylinder of nitrogen under 2000 pounds pressure serves to expel the extinguishing chemical in a

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cloud. The range of this cloud is about 30 feet, and its blanketing effect permits the operator, according to the manufacturer, to approach close to the fire. The extinguisher is said to be suitable for all types of fires and has been approved by the Underwriters' Laboratories for use on class B fires of inflammable liquids.

Among the advantages claimed for the extinguisher are the rapidity of its blanketing and smothering action, its effect of blowing out the flame, the impossibility of its freezing, and non-injurious character of the chemicals.—*A. E. B.*

Neuritis in Car Drivers

MANY drivers of motor cars sit with the window of the sedan open, which permits a constant draft of cold air to strike the shoulder. Doctor Rathelot, a well-known French physician, has just described a condition observed exceedingly frequently; namely, neuritis in the shoulder of the driver who follows the custom mentioned. The pain appears in the shoulder and radiates toward the neck and the back. Cold and damp weather makes the pain more severe and people who have previously been subject to rheumatic disorders are more likely to suffer than those who have not. The French physician describes the condition as a sciatica of the arm, because it is so similar to sciatica in the aged. Apparently it is due to inflammation of the nerves supplying the region concerned. He has not seen a case in drivers of open motor cars, but the condition occurs invariably in drivers of closed motor cars who keep the window open while driving.—*M. F.*

Geophysical Prospecting

HOW valuable some of the geophysical methods of prospecting—for example the seismic or artificial earthquake method and the gravitational or torsion balance method—previously described in the SCIENTIFIC AMERICAN, have proved to be in the oil industry is shown by a summary published in *Oil Weekly* (Houston, Texas), Volume 56, No. 7.

Forty new oil fields have been found though all are not yet drilled. Twenty-two of them are in Texas and 18 in Louisiana. Fourteen new fields were found in 1929 and, when drilled, they gave a total production of 6,302,100 barrels of oil. "It is to the glory of the geophysicists and their science," says Jack Logan, the author of the summary, "that every one of the 14 new fields of 1929 was discovered by the use of the geophysical instruments."

"Falling" of Dew

THE problem of the "falling" of dew has long been one concerning which there are many men of many minds, and their confusion is still confounded, as evidenced by several recent articles about it in *Nature*. One group, esthetic and poetical, says that dew falls, and says it in language often so beautiful that it would be all but sacrilege to question its truth. Another group, looking at the other side of the shield, or, literally, the underside of the leaf, insists that it rises. A third, and pacifist group, urges that both are right, that dew rises and dew falls. This leaves room for only the iconoclast, and that room is taken, for there are those who are emphatic in their statements that it neither rises nor falls. Well, as usual, they are all right and all wrong—each right according to his own definitions of the terms used, and wrong according to the other fellow's definitions.

According to my understanding, all dew is liquid water, except, of course, mountain dew, if any one insists on being so meticulous. Furthermore, it is that particular liquid water that has condensed onto relatively cold objects (objects whose temperatures are below the current saturation or dew point) from immediately adjacent water vapor. According to this definition, dew, a mass of liquid water, does not fall. That would be rain, drizzle or the settling of fog or haze—the descent of water-drops. But even so, we can speak of the falling of the dew in the same correct sense that we speak of the falling of the night, that is, in the sense of gathering as if by falling, or merely in the sense of occurring. And this,

Courtesy General Electric Company

So sensitive is this electrical "chemist" that it can detect mercury vapor in the atmosphere when the vapor is present in a quantity of only one part in 20,000

A demonstration of another use of the photoelectric cell, by Dr. Phillips Thomas of the Westinghouse Electric Manufacturing Company. The photoelectric cell constantly "scans" the white screen. When the demonstrator lights a fire, the cell "sees" it and releases a stream of carbon dioxide, thus extinguishing the flame

I believe, is what most of us, poets and all, mean when we speak of the falling of the dew—merely that it is *forming* or gathering.

However, one may insist, and some do so insist, that even if dew is formed by the condensation of water vapor, the vapor molecules had to get to the place of condensation by motion in some direction—down, up, or sidewise. If the air is still, and if the top of an object is bedewed (a very common occurrence) we doubtless would be right in insisting that the final travel of the vapor was downward, wherever it originally started from and however tortuous its intervening path. In this sense, the sense of final course of the vapor molecules that go to make it, some dew does fall—does go down—not owing to gravitation, but to difference in vapor pressure, a pressure that is least at the place of condensation where the vapor is continuously disappearing or flowing away as if into a sink. In exactly this same sense the dew on the underside of an object, a leaf, for instance, has risen.

Many of the "dewdrops" on the tips of grass and other growing vegetation have not been produced by condensation at all, but by exudation—the flow of water up the leaf and out at its tip or tips. This false dew has, in general, risen. Also it may happen that the absolute humidity (quantity or mass of water vapor per unit volume) immediately over a bedewed lawn, say, is quite as great during the formation of the dew as it was immediately before, owing to an abundant supply of vapor from the damp sod beneath. In this case it may be said that all the dew has risen, the dew on the upper side as well as that on the under side of each and every object.

If, therefore, we adequately prepare the way by definitions appropriate to our needs, we can correctly say that dew falls (in either of two senses), rises, does both, or does neither.

How then about frost—is that frozen dew? Dew in the sense above used, liquid water condensed from vapor, freezes whenever, after it has formed, the temperature falls sufficiently low, whereupon it becomes a kind of frost, but not the fine, white, feathery sort known as hoar frost. This latter variety, by far the more common, is *formed* by the direct condensation of water vapor into ice. It does not pass through the liquid state, hence never was dew and therefore is not froze [illegible] fined.—W. J. Hu [illegible] ence

Lactic Acid

MILK turns sour because the bacteria in it convert the sugar to la [illegible] Now sour milk is not a very popul [illegible] age, but paradoxically, lactic acid is being used more and more in soft drinks and other food products, says J. F. Garrett in a recent issue of *Industrial and Engineering Chemistry*.

Commercially, lactic acid is produced by the fermentation of molasses or corn starch. A fermentation usually requires five to six days for complete conversion of the sugar to lactic acid, although the time may vary widely with conditions. When it is completed, sulfuric acid is added and the calcium lactate converted to lactic acid and calcium sulfate. The latter is filtered off and washed. The resulting weak lactic acid (about 8 percent) is concentrated in vacuum pans to the desired strength.

The leather industry is the principal consumer of lactic acid, utilizing probably 80 to 90 percent of the entire consumption of the country. Its most important function in leather processing is the removal of lime from dehaired hides.

The dyeing and finishing of textiles constitutes an important field for the use of lactic acid, particularly in chrome mordanting and in acid dyeing process as applied to wools.

In recent years a large amount of lactic acid has been used in the production of ethyl lactate, a high-boiling solvent for the nitrocellulose used in the production of pyroxylin lacquers.

The edible and U. S. P. grades of lactic acid are gradually finding increased uses in widely diversified lines of food and beverage products, some of which are infant foods, low-alcohol beers, soft drinks, candies, poultry, and stock foods. In infant

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foods, lactic acid appears to have a corrective effect upon the digestive tract; in near-beers its purpose is improvement of flavor and odor; in soft drinks and certain candies it acts as an acidulent replacing citric and tartaric acids.—*A. E. B.*

Oxygen Treatment

NOW that the life-saving value of oxygen in the treatment of pneumonia and in several other conditions has been definitely demonstrated to be beneficial, attempts have been made to provide simplified apparatus that is easily available and that can be used in the home or in the institution. Special head tents that are easily portable have been developed. Oxygen apparatus formerly used depended on the presence of a motor to blow the air and to keep it in circulation. The motor caused a noise which irritated the nerves. Furthermore, it sometimes stopped suddenly. It required constant lubrication and because of the electrical connections was dangerous when used with oxygen under high pressure. It was also necessary to provide a cooling system which demanded the use of ice and the possibility of leakage of water.

Workers in the Cornell University Medical College have now developed an apparatus which does not require a motor and which has other improvements of great value. In the new device, the motor blower is replaced by an injector and utilizes the high pressure flow of oxygen for its motive power, drawing the air from the hood through the regenerator on one side and forcing it through the cooling system and back through the hood on the other. The device also has a cooling system which avoids the inconvenience of the use of ice by the use of dry ice, or solid carbon dioxide. It is provided with a portable hood containing a window. The operation is simple and would seem to overcome the difficulties with the older types of apparatus.—*M. F.*

Scrap Metal Recovery

DON'T scoff at the junk man! He is really a factor in a tremendous business. According to the United States Bureau of Mines, the value of certain metals (other than iron) recovered from secondary sources in 1929 was $331,027,900, which is $56,416,600 more than in 1928. This increase in total value was almost entirely due to the greater recovery of and higher yearly average price of copper and copper alloys in 1929. There were also increases in the average prices of lead and zinc and decreases in the average prices of antimony and tin. There was a large increase in the quantity of secondary copper and brass and small increases in the quantity of secondary lead and secondary aluminum. The secondary recoveries of zinc, tin, antimony, and nickel showed small decreases.

The shipments of scrap copper and brass to Europe were considerably less in 1929 than in 1928 and the brass scrap re-melted by secondary refineries did not increase. The large increase in secondary copper was that reported by smelters and refineries that treat mainly primary metal, which increased from 116,823 tons in 1928 to 167,079 tons in 1929, and in copper (in alloys other than brass) which increased from 95,000 tons in 1928 to 120,000 tons in 1929.

Oxygen treatment apparatus, described at left, showing hood, mechanism, tank, and the supports

There was a decrease in the quantity of lead and lead in alloys reported by secondary smelters, but those smelters and refineries which treat mainly ore and concentrates reported an increase of nearly 10,000 tons in pig lead and about 4600 tons of lead in antimonial lead from secondary sources.

The zinc recovered by re-distillation decreased about 1300 tons and that recovered by sweating and re-melting about 4000 tons. There were increases in the quantity of zinc dust, lithopone, and zinc sulfate made from zinc residues and drosses and in zinc dross exported, but a decided decrease in the quantity of zinc chloride made from zinc skimmings and the like, in 1929.

The de-tinning plants treated about 17,400 tons more clean tin-plate clippings in 1929 than in 1928 and the yield per ton increased slightly. No old tin-coated containers were treated for the tin coating in 1929, though some were re-melted for window weights. About 76 percent of the recoveries at de-tinning plants was as tin content in tin tetrachloride, tin oxide, and other chemical compounds.—*A. E. B.*

Water Purified by Electrolysis

THE purification of water by the removal of salts from a central section of a cell, through diaphragms, to cells containing anode and cathode poles has been developed in Germany. By passing the water from the central compartment of a series of cells, the water in this compartment becomes gradually purer until the anions and cations are practically all removed. The water so purified, it is claimed, is equivalent to distilled water and can be obtained at a much lower cost. The apparatus consists of 10 cells placed side by side. The purified water passes by siphons through the central compartment of each cell. The anode and cathode waters are removed by wash water, which is fed from dripping nozzles and escapes from overflow pipes in the anode and cathode cells respectively.

Prof. Edward Bartow and R. H. Jebens of State University of Iowa recently tested out the new apparatus and report, in *Industrial and Engineering Chemistry*, that it works very well. They found that tap water containing 725 parts per million of impurities was purified to 15 parts per million by passage through the cells. Since this small residue is chemically inert, the purified water, they say, will serve for most of the common uses of distilled water.—*A. E. B.*

Depths of Earth Yield Frozen Gas

FROM the interior of the earth beneath Jackson County, Colorado, comes snow-white, solid carbon dioxide, which freezes at 70 degrees below zero, Fahrenheit. Enough is obtainable in one day to fill a train, Prof. F. F. Hintze, of the University of Utah, reveals in a report to the American Institute of Mining and Metallurgical Engineers.

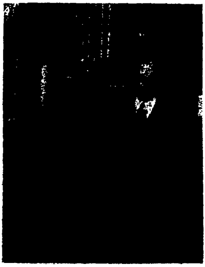
Professor Hintze explains with proper technical exactness that the carbon dioxide tained in the earth as a gas under very high pressure, not as the cold But when it comes to the surface, n with about 10 percent oil, it expands so fast upon being released from confinement and gives up so much heat that it freezes both itself and the oil.

In its frozen state, engineers would apply this gas, the same that is exhaled from human lungs, to the refrigeration and preservation of food.—*Science Service.*

Artificial Wool from Wood

HAVING successfully improved upon the work of the silk worm by developing rayon, the chemist is now turning his attention to the task of going the sheep one better by producing an acceptable artificial wool. A step toward this goal is announced by German chemists who have developed a fiber which they call Vistra. It is made from wood cellulose, converted into viscose, and then pressed through spinnerets of such fineness that 40,000 yards of the fiber weigh only 1 pound.

The wool-silk of another German rayon factory is made from raw rayon, untwisted fibers of which are cut into the proper staple length, curled, and then fabricated. The artificial wool produced in this way costs approximately half as much as washed natural wool.—*A. E. B.*



The rare element caesium is used in the photo-electric cell, shown on top of the cabinet. The layer of caesium is exactly one atom thick —in other words, it is very thin!

The Chemical Kiss

THE skin on the face of a pretty girl is made up of 13 chemicals! John H. Foulger, well-known chemist, Medical College, University of Cincinnati, says 100 grams of skin contain: Water, 61 grams; albumin and globulin, 0.7; mucoid, 0.16; elastin, 0.34; collagen, 33.2; phosphates, 0.032; fats, 0.761; common salt, 0.45; potassium chloride, 0.04; lime, 0.01; also minute quantities of magnesium oxide, iron oxide, aluminum oxide, and sulfur.

Charles Ludwig in the Cincinnati *Times-Star*, is inspired to verse by this chemical analysis of sex appeal.

The skin you love so much to touch,
Now savants tell us, isn't much—
Take thirteen chemicals
And skin jumps from that bag of

In epidermis of
Unite with common iron rust!
Our fairy is not even dust!

And when you kiss and say "Yo
You osculate magnesium!
Her cuticle has lime and salt—
Now will your fondling ardor

Hell's phosphorus and sulfur, to
Come into play when lovers woo
Commingle in the velvet skin
With mucoid and with globulin.

Aluminum in pan and pot
Doth never cost a man a lot:
Much dearer Al_2O_3
In every maiden's cheek you se

There's KCl and H_2O—
How strange that men admire it
The formula you love so well
Has CaO, NaCl

And since the awful truth is ou
Fair skin's no more than sauer
Will gallant lovers now all beat
From cooing trysts a cold retrea

ure put in sl
LAGEN!
Its still small voice doth lure all men—
Depend on it, they'll CALL AGAIN!

—*A. E. B.*

Parasitic Plant May Be Good Food Source

A PLANT with flowers but no leaves, that gets most of its food by tapping the roots of other plants and grows to be 10 or 20 times as heavy as its host, yet without causing the latter any apparent injury, was described recently by Walter T. Swingle of the United States Department of Agriculture. It has the further distinction of being good for human food, and of maturing a good crop on as little as three inches of rain a year—believed to be a record for food plants possible in dry regions.

It was originally discovered about 80 years ago, in the desert near the California- o boundary, but u year ago remained a great rarity. Now, however, it has been rediscovered in great abundance, and has received its first thorough botanical study.

The part used for food is the thick, fleshy root, in which the plant stores water and a reserve of food material. The original dis- rs found the Papago Indians using food, and when they tried it roasted a fire they found it very good. Mr. Swingle suggested that inasmuch as no other useful plant can be induced to grow in this arid region, it might be worth the white man's time to follow the lead of the Indian on a larger scale.—*Science Service.*

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SOUTHERN BAFFIN ISLAND, an account of exploration and investigation and settlement during the past 50 years. *Director, Northwest Territories and Yukon Branch, Department of the Interior, Ottawa, Canada.—Gratis.*

A STUDY OF SOME CHARACTERISTICS OF VEGETABLE OILS (Publication No. 276—Field Museum of Natural History, Botanical Series, Vol. IX, No. 2) by James B. McNair. *Field Museum of Natural History, Chicago, Ill.—25 cents plus postage.*

BROWN PYROMETERS, (Catalogue No. 15A). The urge of industry accounts for the rapid perfection of pyrometers during the last decade. The beautifully executed 100 page pamphlet is almost a monograph on the subject. *The Brown Instrument Co., Philadelphia, Pa.—Gratis.*

MEDICAL DEPARTMENT REPORT, UNITED FRUIT COMPANY, is a valuable work for informing students of tropical medicine of the problems encountered in countries where this company operates. The book can only be sent to those specially interested and is sent gratis to such persons. *United Fruit Company, 17 Battery Place, New York.*

THE SALAMANDERS OF THE CHICAGO AREA (Zoology Leaflet, No. 12, Field Museum of Natural History) by Karl P. Schmidt is a pamphlet with colored and black illustrations. *Field Museum of Natural History, Chicago, Ill.—25 cents.*

RESTORATION OF ANCIENT BRONZES AND CURE OF MALIGNANT PATINA (Museum Technique Series No. 3, Field Museum of Natural History) by Henry W. Nichols, deals with methods which are in use in the Field Museum. This process was first developed by Prof. Colin G. Fink at Columbia University and has been described in this magazine. *Field Museum of Natural History, Chicago, Illinois.—50 cents.*

EFFECTIVENESS OF MOISTURE-EXCLUDING COATINGS ON WOOD (Circular 128, United States Department of Agriculture) by George M. Hunt, gives the results of various experiments made at the Forest Products Laboratory by different investigators on the moisture-proofing of wood by coatings and impregnation treatments. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

KEEPING PACE WITH THE OIL INDUSTRY (Book No. 1259) is an elementary leaflet on petroleum production. *Link Belt Company, Chicago, Ill.—Gratis.*

BUREAU OF ETHNOLOGY, ANNUAL REPORT FOR 1927-1928. Most of the 857 pages consist of scientific papers on anthropology of Salishan, Thompson, and Osage Indians. *Superintendent of Documents, Washington, D.C.—$2.35 (money order).*

OUTLINES FOR STUDIES OF MAMMALIAN LIFE HISTORIES (Miscellaneous Publication No. 86 United States Department of Agriculture) by Walter P. Taylor. Few lines of inquiry possess greater interest or importance than those that deal with the activities of the wild animal in its natural environment. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

AMERICAN MEDICINAL PLANTS OF COMMERCIAL IMPORTANCE (Miscellaneous Publications No. 77 United States Department of Agriculture) by A. F. Sievers deals with a subject of considerable importance to many dwellers in the rural sections of the country as it affords a gainful occupation. The 74 pages are profusely illustrated. *Superintendent of Documents, Washington, D. C.—30 cents (money order).*

AIRWAY MAP OF THE UNITED STATES (Aeronautics Bulletin No. 8, Aeronautics Branch, U. S. Department of Commerce) is a folded map showing lighted and other airways, together with proposed airways. This is an exceedingly valuable and authentic map and can be obtained from *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

COMPARISON OF THE PHYSICAL PROPERTIES OF VARIOUS KINDS OF CAST IRON PIPE (Department of Engineering Research, University of Michigan, Ann Arbor, Reprint Series No. 6) by F. N. Menefee and A. E. White gives valuable facts presented at the Annual Convention of the American Water Works Association. *Department of Engineering Research, Ann Arbor, Mich.—50 cents.*

A PIONEER IN HIGH PRESSURE STEAM, by Geo. H. Gibson, describes the unique contribution of Carl Gustaf Patrick De Laval (1845-1913) the Swedish engineer who was responsible for many mechanical engineering improvements besides the De Laval separator with which his name is usually associated. He originated, according to this pamphlet, the diverging steam nozzle, the high speed helical gear, the flexible shaft, and the use of steam at 750 degrees Fahrenheit and at the critical pressure. *De Laval Steam Turbine Co., Trenton, N. J.—Gratis.*

Geology and Mineral Resources of Northwestern Alaska (Geological Survey Bulletin 815). A comprehensive, 350-page investigation of a previously little known region, particularly with regard to oil possibilities. *Superintendent of Documents, Washington, D. C.—One dollar (money order).*

Geophagy (Field Museum Publication 280) by Berthold Laufer. World-wide studies of the peculiar but widespread human habit of eating earth and clay. *Field Museum of Natural History, Chicago, Illinois.—50 cents (postage extra).*

Data on Metal Base Experimental Road gives particulars of a section of road as constructed in Sangamon County, Illinois. *Poston-Springfield Brick Co., Springfield, Ill.—Gratis.*

OUR POINT OF VIEW

(Continued from page 13)

We do not recall any administration witnesses admitting to the Senate that one bad result of the London pact was the dangerous tension that its deliberations caused between France and Italy. It was openly discussed in Europe but scarcely mentioned here. Unquestionably developments during the London Conference increased the tension between France and Italy, but the basic causes of that tension are conflicting territorial ambitions that now appear irreconcilable and it seems very imprudent for our State Department to assume voluntarily any portion of the responsibility for the present unhappy relations existing between France and Italy.

It is rumored that behind the persuasions of Mr. Gibson is the thinly veiled threat to withdraw British and American financial support to Italy if she does not come to terms with France. In the present state of Italian finances, such economic pressure would amount to extreme coercion, and would involve us deeply in the affairs of continental Europe. The United States should do her part in the various efforts being made to restore stable conditions in Europe, but we should carefully circumscribe the limits of our efforts and resist all temptation to play the leading rôle as Europe's prime pacificator. Such an ambition proved President Wilson's undoing.

Germany—Hitler—Breunig are regularly intervening in European affairs and in a way that may prove to be very helpful to Europe. An American syndicate under the leadership of Lee, Higginson and Company has lent $125,000,000 to the German Premier Breunig to keep the German cabinet in power in spite of bitter attacks by the German Fascists and German Communists. The influence of President Hindenburg was naturally thrown to Breunig's cabinet, but even with that assistance the decision was close.

Unquestionably Hitler's Fascist party more nearly represents the great bulk of German opinion than any other, and it is a safe assertion that no German is really reconciled to Germany's new boundaries or to her liability for financial reparations. For the present Germany is content to pay small installments, mostly with borrowed money, on her reparations and live within her present territories because her wisest leaders are convinced that this is the best course open to her.

Germany is aware that if she bides her time many of her former enemies will soon lose interest in the execution of the provisions of the Versailles Treaty. In Great Britain and Italy majority opinion today is probably in favor of revision of the treaty; only France, Poland, and the states of the Little Entente are strictly anti-revisionists so that in the not distant future Germany may expect that her request for a rectification of frontiers will receive support from some of her previous foes.

Palestine Zionists all over the world are attacking the decision of the British Government to restrict the sales of land in Palestine to the Jews. The government claims that it is only holding an even balance between the interests of the Arabs and Jews, who, together, constitute the bulk of the population of Palestine. No doubt Great Britain would be pleased to wash its hands of the whole matter, but having accepted the mandate from the League of Nations, it must carry on.

At this distance it is impossible to pass on the merits of the case, but Great Britain can not be fairly accused of anti-Semitic feelings. England has entertained less prejudice against Jews than any other European country. Jews not only are prominent in British business but have taken a distinguished part in the British government. It was the oriental ideas of the brilliant Disraeli that made Victoria Empress of India, and in our own time Lord Reading has served as Viceroy of India, the most regal position offered to a British subject. The British government may have erred in its last decision, but it is certainly not inspired by any but good will towards the Jewish people.

Indian Conference There are no idle moments for MacDonald for he has now to face the Indian Conference, that meets in London to determine the future status of India. There are indications of a definite lessening of the tension between the Indian Government, the independent Princes allied to the British Government, and the Indian people of British India, with a growing feeling that a peaceable solution of the problem c[illegible] [illegible]und. Lord Irwin, the present Vi[illegible], [illegible] pursuing a conciliatory policy that has had a good effect on the personnel that will present the Indian point of view at the Conference. There is plenty of good will on the part of the representatives of the British Government and a formula should be found that will satisfy the natural aspirations of the Indian people for a larger share in their government without loosening the bonds of the British Empire or placing too great a political responsibility on an untried electorate.

The whole world, with the possible exception of Russia, will wish the Conference success, for a proper settlement of this disturbing question will directly improve the economic conditions of India and the United Kingdom, and indirectly benefit the trade of the world.

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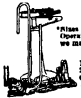

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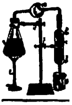

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Consumption of Turpentine and Rosin Increases

MARKED increase in 1929 in the industrial use of naval stores, particularly in use of turpentine for manufacture of paint and varnish was reported in a Department of Agriculture statement just issued. The full text of the statement, as published in *The United States Daily*, follows:

A marked increase in the consumption of rosin and a noticeable increase in the use of turpentine by industrial concerns during the calendar year 1929 is disclosed by the figures just made public by the Bureau of Chemistry and Soils, United States Department of Agriculture, and published at the request of producers and consumers of naval stores.

Industrial consumption of rosin in 1929 increased by 157,384 barrels to 1,104,771 barrels, about 16 percent, and consumption of turpentine reached a total of 5,622,695 gallons in 1929, an increase of 318,596 gallons over 1928, or about 6 percent.

The largest increases in the industrial use of rosin during 1929 were in the manufacture of paper and paper size, soap, and paint and varnish. There was an increased use of rosin by all industries except the linoleum industry, where there was a decided decrease from the quantity used in 1928.

The largest increase in the use of turpentine in 1929 was in the manufacture of paint and varnish. There were also increases in the use of turpentine by manufacturers of chemicals and pharmaceuticals, paper and paper size, printing ink, sealing wax, insulations and plastics, by shipyards, car shops, and so forth, and by makers of shoe polishes, soaps, and for miscellaneous purposes. There was a decreased use of turpentine by manufacturers of automobiles and wagons, linoleum, oils and greases, and by foundries and manufacturers of foundry supplies.

Stocks of rosin at the southern primary ports, distributing points and plants of industrial concerns were larger than they have been for the last two years, while stocks of wood rosin at steam distillation plants were smaller. Stocks of turpentine at southern primary ports, distributing points, and plants of industrial concerns were lower than for the last two years, but stocks at central distributing points were decidedly greater, as were also the stocks at steam distillation plants and destructive distillation plants.

Exports of turpentine reached a total of 16,940,179 gallons, showing an increase of more than 3,000,000 gallons, and there was a slight gain in the exports of rosin from the United States from March 31, 1929, to March 31, 1930, the 12-month period for which export and import figures for naval stores are calculated by the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Turpentine and rosin are among the most important products of a chemical nature exported from this country and show an increase in both instances over exports for the past three years. Imports of turpentine and rosin showed an increase over the previous year, due principally to further development of the industry in Mexico. Imports from France, which were probably at their peak in 1925 and 1926, have continued small. Mexican naval stores are imported mostly into Texas and southern California.

Traffic Signal Patented

A DESIGN patent for a traffic signal was recently issued to Paul P. Horni. In connection with this patent, he appealed the final rejection of the following claim:

"The ornamental design for a traffic signal, as shown."

The opinion of the board follows:

The references relied upon are the following: Meden, design, 58096, June 7, 1921; McOmber, design, 65349, July 29, 1924.

The application involves a design for a traffic signal.

The design comprises a group of four half cylinders arranged in spaced relation symmetrically about a common vertical axis, the cylinders having their flat faces presented outwardly. The half cylinders are united by circular plates at the top and bottom, said plates being provided with radial protuberances which connect to the half cylinders at the outer flat sides. Three lenses and hoods are placed on the flat sides of each half cylinder.

The principal reference relied upon by the examiner is patent to McOmber. This patent discloses the main housing of the traffic signal provided with four flat faces symmetrically arranged about a vertical axis, and the faces connected together by what appear to be somewhat concave walls. The patent also discloses a roof structure overhanging the housing and a base structure attached below the housing. Lenses and hoods are located on the flat faces.

Patent to Meden discloses substantially the same form of hood as in the present design.

The examiner has rejected the claim as not defining patentably over the McOmber patent, taking the position that there is no invention in removing the roof and base structure and modifying the form of the hood as shown by Meden.

It appears, however, that this is not the only thing that the applicant has done. If these changes be made the design would still have a different appearance. The McOmber patent fails to show the semicylindrical sections spaced around a common axis. In the McOmber reference the four faces are connected by somewhat concave plates leaving no spaces between them. The contour and configuration are different. When viewed from different angles it would have a distinctively different appearance. The design as a whole is symmetrical and ornamental and we believe is clearly patentable over the art.

The decision of the examiner is reversed.

Mechanical Goods Are Misdescribed

MISREPRESENTATION of mechanical articles is involved in two stipulation agreements signed recently by respondents with the Federal Trade Commission.

A motor appliance was said to be patented when it was not, while watches which had not been overhauled or reconstructed were advertised as "rebuilt."

Names are not revealed as is customary in stipulation proceedings, but the essential details are as follows:

(1.) An appliance for use in internal combustion motors is manufactured by an individual who advertised it so as to imply that the product is patented, which is not so. He agreed to stop this practice as well as to cease printing false statements on the carton in which his product is packed concerning the price or value of the article, and supplying customers with an article labeled with a false price known to be in excess of that at which it is usually sold at retail.

(2.) Signing a stipulation, a corporation jobber of fountain pens, pencils, watches, and novelties agrees to stop using the word "rebuilt" as descriptive of watch products which have not in fact been overhauled or reconstructed.

The company agrees also not to carry in its advertisements addresses of factories, and to discontinue employing the word "factories" in a way that would imply to buyers that the company owns or controls the factories indicated, wherein these watches are made, when such is not true.

Garment Trademark

IT was recently held by First Assistant Commissioner Kinnan that the American Maid Undergarment Company, of Chicago, Illinois, was not entitled to register as a trademark for ladies' and misses' gowns, bloomers, and so forth, a mark consisting of the representation of a young woman partially clad in an undergarment, seated before a dresser, beneath which appears the words "American Maid," in view of the prior use by the American Maid Company, of New York, New York, of a mark for the same class of goods which consists of the pictorial representation of the standing figure of a young woman clothed in undergarments and stockings, back of which figure is a black disk less in height than that figure, with the words "American" and "Maid" appearing on the right and left hand sides respectively of these features, and that the registration which had been obtained by the American Maid Undergarment Company under the Act of 1905 should be cancelled.

After noting that the petitioner for cancellation had taken testimony but the applicant had not, that that testimony established adoption and use prior to the registrant's date of filing and the only question therefore related to the similarity of the marks, he said:

"There is some showing that the petitioner has used its mark without the figure of the standing young woman but this is deemed immaterial. The use of the mark including the pictorial representation of the standing figure of the young woman is certainly not shown to have been abandoned. Both marks use the same distinctive notation, "American Maid," and the pictorial representations of the figures emphasize the meaning of this notation. It seems plain that customers would call for the goods by these words. It would be difficult to describe the marks, in calling for the goods, in any other way. . . .

"Being familiar with the petitioner's mark and seeing that of the respondent upon the same class of goods, customers would be led to suppose the variation in the pictorial representation merely indicated some particular or different kind of undergarment put out by petitioner rather than that it represented a different origin."

Priority Must Be Proved

THE trademark shown in the application of the Hawaiian Pineapple Company, Ltd., of San Francisco, California, and Iwilei, Hawaii, consisting of the words "Royal Palm" appearing between the pictorial representation of two palm trees is registrable over two prior registrations cited by the examiner but is so similar to the mark of the West Indies Fruit Importing Company, Registration No. 223,555, that it is not registrable to the applicant unless priority of adoption and use is proved.

In the decision handed down, after noting that the applicant had previously registered the words "Royal Palm" alone and also noting the statement of the examiner that when in the present application the representation of palm trees was included it gave the mark much greater similarity to that of the West Indies Fruit Importing Company and stating that applicant's mark was no more similar to two of the registrations cited than was the mark of the West Indies Company, the First Assistant Commissioner said:

"It is considered, however, to be plain enough that the applicant must be denied registration in view of the registration to the West Indies Company unless the applicant was the prior user of this composite mark including the words and the representation of the palm tree. Since the applicant alleges a date of adoption and use prior to that set forth in the registration of the West Indies Company and asks for an interference it is thought proper that such a proceeding should be instituted."

Wall Board Trademarks

IT was recently held by First Assistant Commissioner Kinnan that Bronston Brothers and Company, Inc., of New York City, New York, is entitled to register, as a trademark for wall board, calcined gypsum, and so forth, the notation "Flametex," notwithstanding the prior adoption and use by the Celotex Company, of Chicago, Illinois, of the term "Celotex" as a trademark for wall board and similar material.

The ground of the decision is that the marks taken as a whole, in view of the use by others of the notation "tex" in various marks, are not so similar as to be likely to cause confusion when used upon goods of the respective parties.

In his decision the First Assistant Commissioner, after stating that the marks are wholly dissimilar except for the last syllable, said:

"Viewed in their entirety, the common portion is regarded as such a minor part that confusion or mistake is deemed unlikely. Purchasers of goods of this kind may be distinguished from those who purchase small articles which sell for a few cents and such as are called for by servants and children, and ordered over the telephone. It does not seem that anyone who would purchase wall board would be at all likely to be deceived or misled if the two marks appeared in the same market upon these goods. The first and dominant portion of each mark is more likely to be noted by purchasers and the wide dissimilarity between 'Celo' and 'Flame' would seem sufficient guaranty against confusion."

He then stated that a number of trademarks ending in the syllable "tex" as previously registered for goods of this same general class had been noted, and that the Court of Customs and Patent Appeals in the case of the Apex Electrical Manufacturing Company *versus* Landers, Frary and Clark (not yet published)

* * * noted that "Prior registrations may be shown to prove that a word or symbol in a registered mark has so frequently been used in prior trademarks, registered or unregistered, as to make such word, as applied to particular goods, public property," but found in that case no such showing had been made.

Mr. Kinnan also held that the Chicago Panelstone Company, of Chicago, Illinois, is entitled to register the notation "Opal-Tex" as a trademark for ornamented wall board notwithstanding the prior adoption and use by the Celotex Company, of Chicago, Illinois, of the notation "Celotex" for wall boards and material of a like nature.

The reasons given for the conclusion reached are the same as those given in the decision of the Celotex Company *versus* Bronston Brothers, appearing immediately above.

Mechanical Feature Is Not Trademark

IT has been held that the National Stone Tile Corporation, of San Francisco, California, is not entitled to register, as a trademark for hollow tiles, a mark said to consist in a groove or depression formed in the transverse web and end walls of one side only of the tile.

The ground of the decision is that such a groove has mechanical function and is an integral part of the tile and consequently can not serve as a trademark.

In his decision, after noting that affidavits had been submitted by the officers of the appellant corporation that this depression or groove was adopted solely for trademark purposes, and noting further the argument that it is difficult to place properly on such articles a suitable trademark and calling attention to the patent to Nelson, 1,572,305, in which a groove, somewhat deeper than that shown in the trademark drawing, is placed in a tile for mechanical purposes, First Assistant Commissioner Kinnan said:

"It is evident that if the appellant obtained registration of its alleged mark the patentee could not manufacture the tile disclosed in his patent without infringing this trademark. While the appellant claims to have adopted this form of tile long prior to the date the patentee filed his application, yet if registration were granted, it is clear the appellant would in effect obtain a perpetual patent for a tile of this type, since a trademark registration may be renewed indefinitely."

And then, after stating that, whatever may have been the purpose in adopting the groove in this tile, such a groove would, when the tile is used, serve the purpose of ventilating the wall as well as furnishing a channel through which electric wires could be run, he continued in the following manner:

"It seems also quite probable that the purchasing public, even if it recognized that the tile is of a character made only by the appellant corporation, would not look upon the depressions or grooves as constituting a trademark. In connection with this holding, attention is invited to the decision in the case of Herz v. Loewenstein, 192 O. G. 993, 40 App. D. C. 277."

Oil Mark Refused

IN the case of Barstone Oil Company *versus* American Oil and Supply Company, Assistant Commissioner Moore held that the American Oil and Supply Company, of Newark, New Jersey, is not entitled to register, as a trademark for lubricants, the term "AmOviS" in view of the prior adoption and use by the Barstone Oil Company, of Chippewa Falls, Wisconsin, of the term "MorVis" as a trademark for the same goods.

The ground of the decision is that the marks are confusingly similar as applied to the goods in question.

In his decision, after noting the specific differences between the marks, the Assistant Commissioner said:

"As to sound, the two marks are regarded as confusingly similar when pronounced as they would be by the average member of the purchasing public.

"As to appearance, while on comparison differences would be observed, yet, when the two marks are carried in the memory, it is believed that those differences would be forgotten."

With respect to the applicant's argument that in view of prior registrations no one is entitled to a protection so broad as to prevent another from including the syllable "vis" in a dissimiliar mark and noting certain decisions, he said:

"I am of the opinion that the two marks, when considered as a whole, are confusingly similar to each other and that the rule applied by the courts in many cases to the effect that the newcomer should not adopt a mark closely approximating that of an earlier user should be applied in this case."

BOOKS SELECTED BY THE EDITORS

ASTRONOMY—*By R. H. Baker, Prof. Astron., Univ. of Ill.*

THIS is the latest in general astronomies. It gives one a start to find in a standard text book accounts of events that occurred, seemingly, almost yesterday. Various astronomers and special astronomical journals have given this book flattering reviews and even a partial reading of it shows why. It honestly deserves them.

There already were four good, modern astronomies—Fath's, Mitchell and Abbot's, Russell, Dugan and Stewart's, and Duncan's—each differing in length, depth, purpose, and appeal, each therefore needed today in the scientific book collection of the well-informed non-professional reader.

Baker's new book is quite large (6⅜" by 9¼"; 505 text pages) and is profusely illustrated. Some of the drawings explain better than words do, certain common beginners' "puzzle points," and the specialized works named at the ends of the chapters indicate careful selection. This is another invaluable aid to the isolated reader who, if he buys further reading matter, wants it to be *the* book on the subject and not just *a* book. The author's style is simple and direct, not the well-known eight-jointed-word or sesquipedalian style.—$3.90 postpaid.—*A. G. I.*

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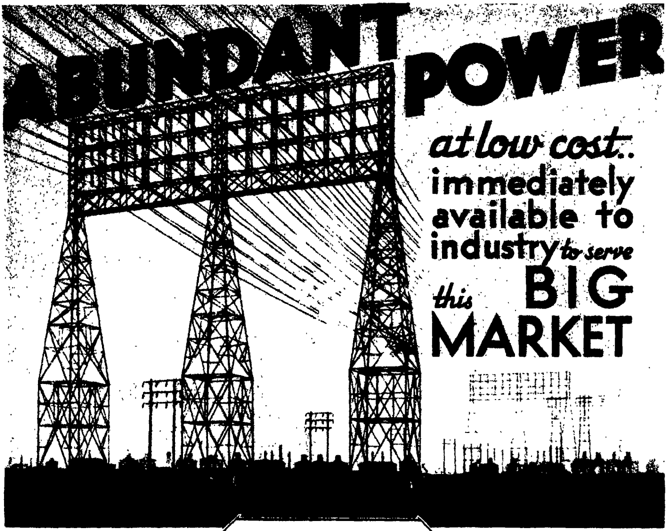

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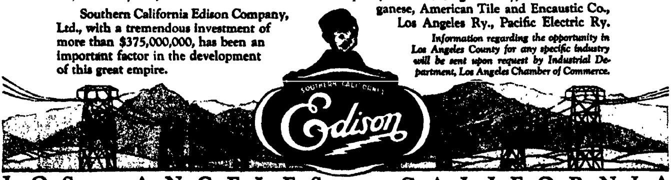

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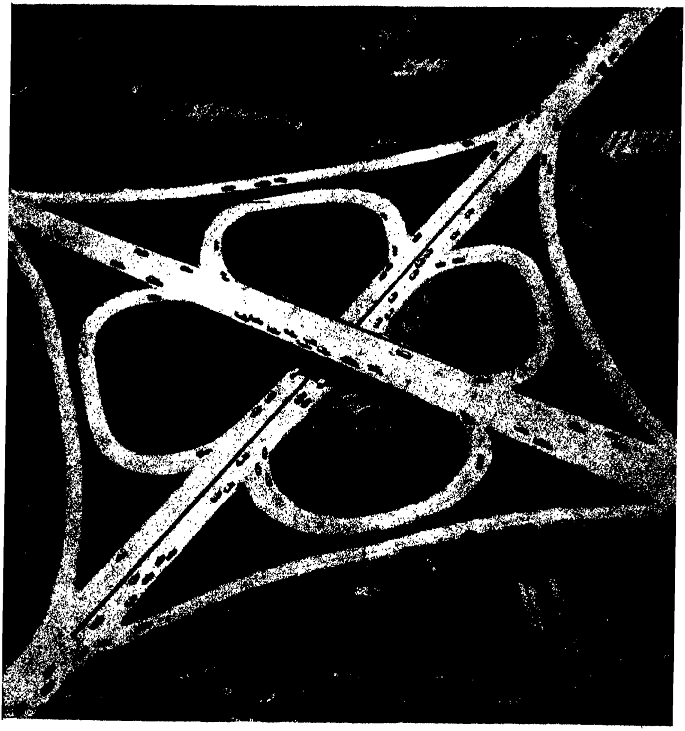

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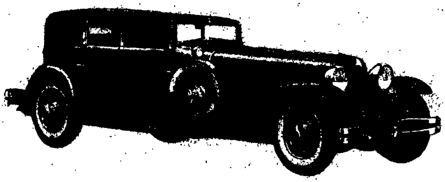

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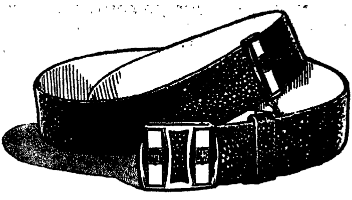

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SCIENTIFIC AMERICAN, February 1931, Vol. 144, No. 2 entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Scientific American Publishing Company, 24 West 40th Street, New York City. Copyrighted 1931 by Scientific American Publishing Company, Great Britain rights reserved. Subscription price $4.00 per year. Foreign $5.00.

SCIENTIFIC AMERICAN

Owned and published by Scientific American Publishing Company; Orson D. Munn, President; Louis S. Treadwell, Vice-President; John P. Davis, Treasurer; I. Sheldon Tilney, Secretary; all at 24 West 40th Street, New York, N. Y.

EIGHTY-SEVENTH YEAR • **ORSON D. MUNN, Editor**

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THIS MONTH'S COVER

The rapid increase in the number of automobiles in this country has necessitated not only the development of new methods of highway construction but also the laying out of intricate new systems to eliminate traffic congestion. Of the latter, perhaps the most striking is that pictured in pastel shades by our artist Howard V. Brown. This "clover-leaf" cross-roads is part of the New Jersey Highway System and lies between Rahway and Woodbridge. To make a turn either to the right or the left or even to reverse one's direction on either of the roads at this crossing, a right turn or two does the trick; a left turn is never necessary, in fact is not permissible. Study the painting and prove it for yourself.

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ACROSS THE EDITOR'S DESK

TO the motorist who takes an interest in automobiles aside from their use for transportation, the beginning of a new year holds forth the promise of developments in the automotive field that will affect him directly, either in the purchase of a new car at once or in the replacement of his present car in the near future. What improvements or innovations are to be found in this or that car? Will my car be rendered obsolete by the newer models? What is this new feature called "free-wheeling"? How are the 16-cylinder cars coming along? These and a host of other questions come to his mind. In this, our Annual Automobile Number, we have collected material on many of the branches of the automotive field that either gives the direct answer to questions such as these or lays down data from which definite conclusions may be drawn.

●

One thing is certain: manufacturers of automobile accessories are going to be affected by the general trend toward complete equipment on the newer cars. No longer need the new-car buyer invest a substantial sum in heat indicators, mirrors, ash trays, air cleaners, oiling systems, and so on. They are all there when the car is delivered. On the other hand, those of us who have, of necessity or choice, to keep our old cars for another season, constitute a potential market for "gadgets" of various kinds that have been developed since our cars were made.

●

To avoid a straight diet of automotive news in this issue, we have scattered through it articles of general interest. Our old friend Harold Cook has written another description of archeological finds that strongly suggest the existence of early man in America. It is odd—some readers may call it significant and others merely accidental—that none of the finds purporting to establish ancient man in America stands out as absolute proof of it. Conservatives tell us that the explanation is simple: the proof is lacking because early New World man was lacking. Perhaps, but it is early yet to dogmatize. Until the balance of knowledge swings one way or the other, every suspicious sign should be investigated.

●

One mile of vacuum. A mile is not such a long distance, as distances go, but try to keep all of the air out of a tube three feet in diameter and a mile in length! That is the engineering problem that had to be solved before Professor Michelson's latest experiment on the velocity of light could be started. And it was solved in a remarkably simple yet effective manner. The writer who tells of the work in this issue is a member of the scientific-technical staff of the institution that planned and executed the installation of the pipe that "holds a mile-long vacuum." So far as we know—correct us if we are wrong—this is the biggest man-made vacuum on record.

●

Over in Egypt the Metropolitan Museum of Art has been conducting excavations for several years, and the results have been most gratifying. One intriguing statue of Hat-shepsut was found—all but the head. Eventually that was found—in Germany. It had been located and removed by former excavators. Negotiations were opened and, with the fine unselfish spirit of science, arrangements were made whereby the body and head were once more joined. The final chapter of this running story of archeological triumph is in this issue.

●

The tentative schedule for our March issue presents a diversified collection of material. First there is the mystery of the aurora borealis. What is it? There are several theories that attempt to answer this question, but all lack the proof that science demands. At our request, a scientist of note has written an article outlining the various hypotheses, old and new. The mystery still remains, but the attempts at explanation afford intriguing food for thought.

●

Then there is an article about a new system of aerial photography whereby promising sites for oil wells are located. How are miniature and life-sized groups of animals prepared for museums? A series of photographs and a short, meaty article will reveal the secrets of the art. Fish ladders have been constructed around large dams so that fish can go upstream to spawn. The largest meteor ever located after it was seen to fall is now on exhibition. The hardiness of winter wheat can be determined electrically. A floating power plant has been designed to help out, when needed, local power plants along the coast of Maine. More about the pre-historic inhabitants of North America. . . . We could go on and on telling about the features of our March number, but the limits of this page close in and, after all, only the issue itself can do proper justice to its contents.

The Person of Evolution

By W. D. LIGHTALL, L.L.D.

MOST profound men of science—Compton, Millikan, Russell, Eddington, Haldane—have invaded the domain of philosophy and have evolved a scientific religion which rationalizes the more common emotional, revealed type to explain our inherited memories, fears and instincts. This book treats of these higher aspirations to coordinate religion and science. $2.20 postpaid.

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By TOBIAS DANTZIG
Prof. Math. Univ. Maryland

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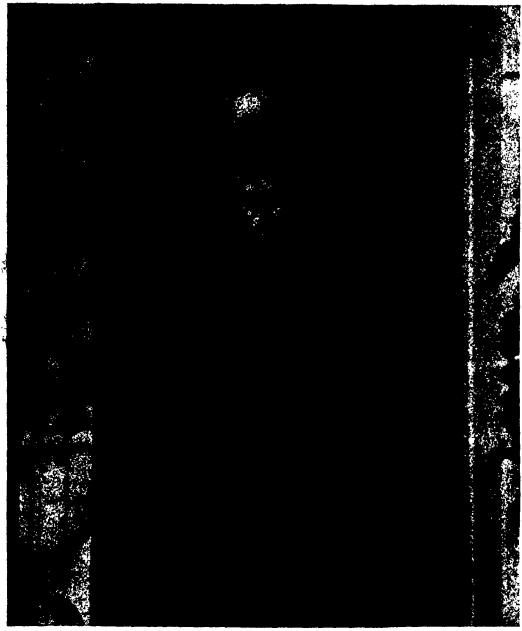


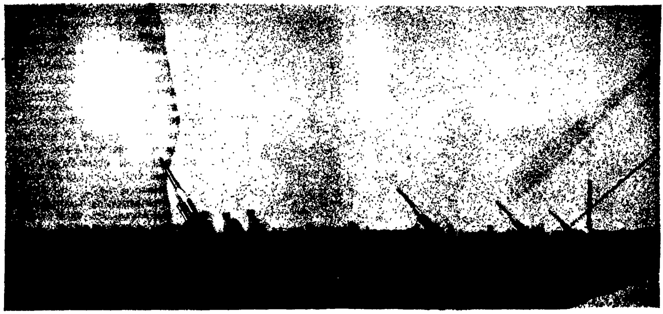
F. HENRY ROYCE

IN 1903, Mr. Royce, an Englishman, bought his first automobile but, terrified at its noise and lack of reliability, took it to pieces and was amazed at the absence of the fundamentals of sound engineering principles in which he had been schooled under the famous builder of locomotives, Patrick Stirling. In his exasperation, he designed a car for himself, and built three from the working drawings. One he kept, one was given to the chairman of Royce, Ltd., makers of electric cranes, and the third was lent to the Hon. C. S. Rolls, famous amateur sportsman, racing driver, and balloonist. Mr. Rolls was so enchanted with his new car that he offered to help Mr. Royce finance a company to build fine motor cars and to assume responsibility for the sale of the total output. So the Rolls-Royce Company was formed and the world-wide reputation of its product is evidence of the reward of devotion to high ideals. Mr. Rolls later became interested in aviation and was killed in a plane crash in 1910.

The evolution of the Rolls-Royce aero engine is an epic in itself, and is marked with notable achievement. The first flight across the Atlantic, from Newfoundland to Ireland in 1919, was made in a Vickers Vimy biplane equipped with Rolls-Royce engines. In 1929, the Rolls-Royce Supermarine S-6 seaplane won the Schneider Trophy contest and now holds, unchallenged, the world's speed record at 357.4 miles an hour.

CONCENTRATED "POISON" FOR AIRCRAFT

FOUR .50-caliber machine guns together with stereoscopic height finder and Vickers data computer are mounted on the rotating platform of this mount which is described on page 84. At the top is shown the business end, or front, of the guns, and below is shown the back. The chassis is a specially designed Diamond T with 12 service tires and two spares on idler shafts



A battery of three-inch anti-aircraft guns in action at Aberdeen

PREPAREDNESS FOR PEACE

By F. D. McHUGH

SPEAKING of war, in a recent interview, General Pershing said: "With all my soul I hate it!" but added that well-meaning people think that we can abolish war by disarming. "We do not believe in war," he said, "but there are others who do. . . . Unfortunately wars do come, and sometimes when we are thinking least of them. . . . And so we must maintain an effective instrument of national defense. We must be ready should any nation choose to force a war upon us."

One does not have to hold militaristic ideas to agree with this thesis. Despite the Kellogg Pact and the strenuous endeavors of far-sighted statesmen to achieve a lasting peace, competent observers tell us that the world right now is rank with intrigue, international jealousies and hate, and that the slightest spark might possibly start a world conflagration more disastrous than the World War. No nation *expects* war, but students of world affairs since the War are, we believe, convinced that our greatest insurance against future wars lies in preparedness; and by that term we [illegible] not mean preponderant strength [illegible] rather quality and effectiveness in all things of a military nature. "Quality—not quantity" may, in fact, be called the keynote of the post-war work of our military forces. They have more than ever before placed their faith in science rather than in strength, for science is a vital factor in military power

The Army Ordnance Department, perhaps above all other branches of the service, has taken full cognizance of this fact; and some of its more important applications of science to its problems were shown in a spectacular demonstration at Aberdeen Proving Ground, Maryland, last October. Conducted by that branch of the service, with infantry and Army and Navy aviators participating, the demonstration marked the 12th annual meeting of the Army Ordnance Association.

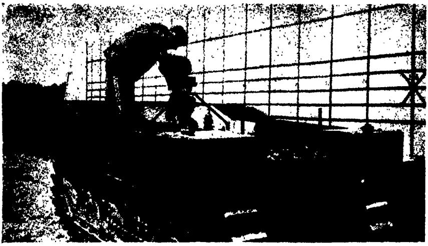
THE Army Ordnance Association is a nation-wide organization of executives and engineers of American industry who are pledged to industrial preparedness for war as our nation's strongest guarantee of peace. It is the antithesis of militarism, its sole aim being to assist in keeping American industry in readiness to produce the munitions that would be required by the fighting forces in case of a major war emergency. This it endeavors to do by keeping alive an interest in and a knowledge of the design, maintenance, and supply of munitions. This problem is one of vital concern because of the facts that we have no peace-time industry for the manufacture of ordnance, that we have only six manufacturing arsenals, and that, in the event of an armed conflict, time would not permit careful study or long preparation for the production of munitions.

The Army Ordnance Association believes that the solution of this problem lies in an active organization co-operating at all times with the government, and its objective is an active membership of American citizens on whom the duty of design and production of munitions will fall in time of war, who will have an accurate and authentic knowledge of the complex requirements of ordnance.

Each year in October many members of this organization journey to the Aberdeen Proving Ground in Maryland in order to get a composite picture of developments that have been made, and to learn what new problems are being worked out and what others must be tackled.

The last meeting was particularly interesting and instructive since members and their guests had the privilege of seeing demonstrated for the first time publicly several developments that mark a distinct advance over past practice. In describing some of these, we shall abstract, by permission, much technical material from a recent article by Lieutenant-Colonel E. M. Shinkle, Commanding Officer of the Proving Ground. His article was published in *Army Ordnance*, the official magazine of the Army Ordnance Association. And, since the demonstration at Aberdeen is less important, *per se*, than the story of developments, it will be discussed toward the end of this article.

In the province of exterior ballistics, the actual resistance functions of projectiles have been determined with what is believed to be a high degree of accuracy. If the greatest accuracy is to



A movie camera used in place of a gun to determine the stability of a tank chassis as a gun mount. The movies constitute an accurate, permanent record

be obtained in making up firing tables showing the effect of abnormal conditions on the range—variations in wind, muzzle velocity, and air density—it is essential that these tables be based upon the knowledge of the particular projectile in question. The projectiles for which the resistance functions have been determined are a 75-millimeter shell with a moderately long point and a boat tail, the three-inch common steel anti-aircraft shell which has a blunt point and a flat base, the three-inch common steel shell which has a long point and a flat base, and the 4.7-inch, model E1 shell which has a long point and a boat-tailed base.

In studying the exterior ballistics of small arms bullets, photo-electric cells and spark photography are being put to use. The photo-electric cells are used in measuring the velocities and retardations of bullets, and the spark photography to obtain a picture of the bullet which will enable the yaw of the bullet to be determined.

The photo-electric cell, together with a powerful amplifier, has been made to serve as an instrument for obtaining an automatic record of the time of flight of anti-aircraft projectiles. The amplifier in this apparatus is so arranged that it causes a spark to perforate a piece of paper which is carried on the drum of a chronograph. When the gun is fired, the light of the muzzle flash causes the first spark to jump, and the burst of the projectile at a remote point of the trajectory causes the second spark. The photo-electric cell has also been applied to the measurement of velocity of projectiles. The apparatus for this purpose is so constructed that when the projectile passes overhead, a reduction in the light impinging on the cell is recorded by means of an amplifier on an oscillograph or other instrument.

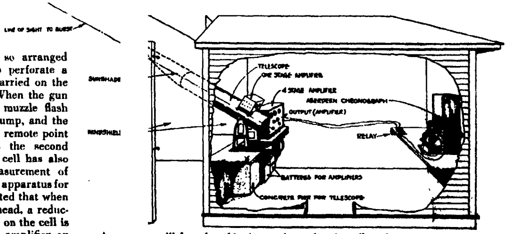
Science has also been applied to the problem of obtaining a record of the impact of inert bombs on the ground, and also to record the delay of bomb fuses. For this purpose a very sensitive apparatus based upon the vacuum tube oscillating circuit has been made. The ground shock from the impact of bombs, slight as it is, causes a change in the separation between two metal plates, the capacity between which forms part of the capacity of the oscillating circuit. When this capacity changes, the plate current of the vacuum tube changes. This change in the plate current is amplified by an audio-frequency amplifier which finally causes a record to be made by a pen on a chronograph drum. This apparatus has been found so sensitive that records have been obtained with it of the impact of 17-pound bombs on rather soft ground at a distance of 1200 feet from the apparatus.

Since the World War a wide variety of automotive equipment including tractors, tanks, self-propelled gun mounts, and trucks suitable for prime movers for guns, have been tested at the Proving Ground. Since these have been covered more or less fully in past issues of SCIENTIFIC AMERICAN, we shall limit ourselves here to the description of a recent test made to determine the suitability of a tank as a moving gun-platform. The relative stability of the tank was first shown by running various tanks over a course at different speeds, the gunner successfully making a number of hits on the target in this test. A more successful method was to mount a high-speed motion picture camera on a tank chassis as a gun and take with it moving pictures of a grid system painted on the side of a building while the tank was in motion. Measurement and analysis of these pictures give much information of importance as to the suitability of the platform as a gun mount.

The program at Aberdeen last fall began with a demonstration of small arms. Caliber-.30 Browning machine guns fired tracer bullets; caliber-.50 machine guns and three-pounder guns were fired from tanks; and semi-automatic shoulder rifles were exhibited in action.

THE most marked development in small arms since the World War is in the high state of efficiency to which semi-automatic shoulder rifles have been brought experimentally. Until recently it was believed impracticable to design such a rifle firing a caliber-.30 bullet at service velocity within a weight approximating that of the Springfield Model 1903 rifle. Accordingly, extensive experiments were undertaken to determine the effect at various ranges of a bullet of smaller caliber—namely, .276 inch. At the direction of the War Department, tests were conducted on semi-automatic rifles of this caliber in 1929, seven such rifles being submitted and five of these being tested. Of those tested, three were American—two having been designed and manufactured at the Springfield Armory—and two were of foreign manufacture.

Tests have shown that a partially



Apparatus utilizing the ubiquitous photo-electric cell and v[illegible] tain an automatic record of the time of flight of various anti-aircraft projectiles trained rifleman can obtain twice as many hits per minute with a satisfactory semi-automatic rifle as with a separate loading rifle of the bolt type. Colonel Shinkle says that it seems not too optimistic to say that in case of necessity, production can be started at once on a satisfactory type of semi-automatic shoulder rifle; and, further, that at least four such exist in experimental form at this time.

Following the demonstration of small arms matériel a 75-millimeter gun was fired, first with black powder which flashed brightly and gave off a quantity of heavy smoke, then with smokeless powder, and finally with a smokeless and flashless powder, this exhibition demonstrating the progress that has been made in the development of propellant powders.

IN developing flashless non-hygroscopic powder—FNH powder, the last named in the paragraph above—it was found that ignition methods used with other powders were less satisfactory with this new type. The size of the primer necessary for proper ignition—according to chamber and bore of the gun—has required much study. Much firing has been done on a carefully arranged experimental program to determine fundamental data on the conditions essential to the ignition of FNH powders to secure uniform interior ballistics and flashlessness without an objectionable amount of smoke. The smoke is objectionable for day firing and the flash is objectionable at night. This problem is still being studied and it is thought that the ultimate solution may be the use of a larger primer to give complete ignition and no excessive smoke, with the provision that a small amount of flash reducer be added to secure flashlessness at night. At the present time a complete solution of this problem for the three-inch anti-aircraft gun is being sought.

After the demonstration of powders, the trajectory of the 75-millimeter gun was shown by firing rapidly a number of shrapnel shells with their fuses set in such a manner that the bursts of the shrapnel were approximately simultaneous despite the fact that they were fired one after the other from the same gun.

Mobile artillery matériel were next shown in action. These included the infantry mortar M1, the pack howitzer M1, and the M1 gun, all of 75-millimeter caliber; and the 75-millimeter gun on truck mount T3 which was described in our October, 1930, issue.

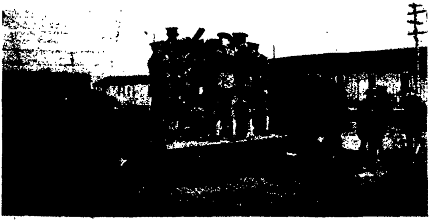
The 75-millimeter infantry mortar mentioned above is the latest development in this type of weapon. It is a smooth bore gun, firing a vaned projectile weighing about 10⅝ pounds to a range of 2000 yards. The mounting allows a traverse of 13 degrees without moving the trail, and an elevation of 80 degrees. In firing position it weighs 362 pounds and with accessories, 422 pounds; and is so built that it can be broken down into five one-man loads for transportation. In demonstrating it, the difficulties confronting the experts who are developing ammunition for it were indicated when a poorly designed and a well designed projectile were fired from it. Since the speed of this projectile is slow, its flight could be followed by the eye to the peak of its trajectory. The poorly designed projectile was seen to tumble over and over like a stick of wood when thrown, while the properly designed projectile went ahead on a straight, nose-forward course.

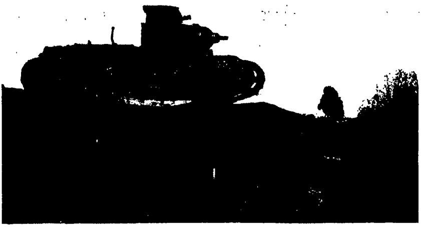
Ammunition for this mortar has not been standardized, but will probably be a shell equipped with cast aluminum or steel fins. Ignition is obtained with a shotgun shell and it has a short brass cartridge case which will probably be fastened to the fins by crimping. It has greater accuracy and range than the Stokes mortar used in the World War, but its fire is slower due to the breech loading.

The 75-millimeter infantry mortar is the latest development of a weapon of this special type

A 105-millimeter howitzer was next fired, followed by a 75-millimeter gun which was developed for division artillery, and a 155-millimeter howitzer for use in the corps artillery. The last-named piece was designed to fire a 95-pound projectile to a range of 16,390 yards, but recent tests have indicated that a range of over 18,000 yards can be safely obtained. Actual practice therefore improves upon the designers' calculations.

AFTER further artillery demonstrations, mimic warfare of a most spectacular nature took place. This was the special "show" of the mechanized forces. First, there was heard overhead the drone of observation planes which observed "enemy" positions in a distant field before us, and then made their report. Fast armored cars advanced to obtain further, more detailed information. Then the long range artillery—the 4.7-inch gun, and eight-inch howitzer on self-propelled mounts; anti-aircraft elements represented by four-gun and two-gun, caliber-.50 machine gun mounts; light artillery; and chemical mortars, moved, or were moved, rapidly into position to prepare for and to support the infantry attack. After a terrific fire by all these units a


The Sperry director, manned. This photograph was taken while this complex instrument was directing the fire of the guns shown in operation on page 81



A medium tank entering a trench in a Proving Ground test. A recent development, this tank is formidable, speedy, and not so cumbrous as wartime heavies

fast medium tank—the Christie tank which has been described in SCIENTIFIC AMERICAN—followed successively by medium tank T2, light tanks, and a Mark VIII tank, rushed the principal "enemy" positions to crush machine gun nests and pill boxes. Firing the .50- and .30-caliber machine guns, 37-millimeter guns, and three-pounders, they rapidly crossed the rough terrain, scoring many hits, being supported from the rear by artillery.

The tanks having effectively eliminated the strongest concentrated positions, fast cross-country cars and cargo carriers brought up platoons of infantry to strategic points where they were unloaded to "mop up" with automatic rifles and to emplace machine guns. The divisional infantry then deployed and moved forward to hold the positions.

THIS spectacular demonstration is significant in that it showed strikingly the perfect co-ordination between air, artillery, mechanized, and infantry forces that might be expected in an actual battle. It showed further the amount of study that has been involved in correcting one serious fault common during the World War; that is, lack of co-operation between various units.

While on the subject of the mechanized forces it is appropriate that one other recent development be described. This is the T1 multiple machine gun mount. It consists of a truck chassis carrying a pedestal-mounted platform with a 360-degree traverse, which mounts four .50-caliber machine guns together with fire control instruments. A four-wheel driving bogie in the rear has great flexibility, while on each of the front, or steering wheels, there are two tires of different diameters. The outer tires are smaller by two inches than the inner ones so that only one tire of each front wheel bears on hard ground, and both tires of each wheel make contact when on soft ground, increasing the effective tire area. An added, unique feature is that the two spare wheels with tires are mounted on each side of the chassis "amidships" on freely turning idler shafts so that they bear on obstructions over which the truck may be traveling and prevent the chassis from striking such obstructions.

On the firing platform with the four machine guns is a three-meter stereoscopic height-finder and a Vickers data computer. The height-finder aims the guns; and predictions of the future positions of the moving aircraft target are made automatically and directly to the guns by the data computer.

AS the program continued, airplanes made their appearance and gave a splendid account of themselves, flying in formation, stunting, "dog fighting," firing machine guns at land targets, and bombing.

After a single round fired from a 16-inch gun on a barbette carriage and a round fired from a 14-inch gun on a railway mount, the demonstration was continued on the anti-aircraft range. The 69th Coast Artillery (A.A.) fired anti-aircraft guns of the following types: .30-caliber and .50-caliber multiple-mount machine guns; 37-millimeter guns, 105-millimeter guns, and three-inch guns.

Both the three-inch and the 105-millimeter anti-aircraft guns are equipped with removable linings which have been mentioned previously in SCIENTIFIC AMERICAN, representing a marked advance in gun construction. When the lining of the gun has been scored by a great number of shots so that its accuracy is impaired, these reliners are inserted on the spot, thus obviating the necessity of returning the gun to an arsenal for relining.

The fire of both types of these guns is controlled from an anti-aircraft director, a complex instrument which, with a height-finder, determines the instantaneous positions of the target, predicts the location of the target at the end of the time of flight of the projectile, computes the firing data necessary to hit that location, corrects the data for any abnormal ballistic conditions, and transmits the corrected firing data to the guns. All of these operations go on continuously so that the guns are correctly laid at all times by matching the pointers of the electrical data receivers.

THESE guns were fired at a sleeve target towed several hundred yards behind an airplane flying at a high altitude. The location of each burst with reference to the target was accurately determined by motion pictures taken by two cameras. It was later computed that, during the firing, an average of one hit was made every 10 seconds. As a dramatic conclusion to this event, the towing cable was hit as the airplane made its last flight before the guns, and the target fell to the ground.

The demonstration was brought to a close by further anti-aircraft firing after dark. It was then necessary for searchlights to illuminate the targets. The direction of the target was accurately determined by sound locaters. The predicted position of the target was continuously computed and transmitted to the searchlights electrically, so that they were correctly pointed by matching the pointers of the instruments. When the lights were switched on, the target was found in or near the beam from one of the several lights. All the beams were then kept on the target by observers who could train the searchlights from stations somewhat removed from the light positions. Application of this control apparatus to searchlights is a recent development.

The night firing was very spectacular, for in addition to the cross beams of several searchlights piercing the sky, streams of tracer bullets mounted skyward from the .50-caliber machine guns and the 37-millimeter guns. From a position to the rear of the firing line it seemed that many hits must have been made not only by these guns but also by the three-inch guns, the projectiles from which seemed to burst all around the target.

Major-General Samuel Hof, Chief of Ordnance, made a statement in his recent annual report to the effect that our tanks "equal, if they do not surpass, those of any other nation." Guests at the Aberdeen demonstration feel [illegible] this statement could [illegible] broadened [illegible] include many other units of our mechanized force and a wide range of munitions as well. A review of the developments should convince anyone that, in the application of scientific principles to the solution of [illegible] problems, the Ordnance Department has made praiseworthy, tremendous progress in the interests of peace.

OUR POINT OF VIEW

A Bright Future?

WHAT of the automobile industry for 1931? This question, so vital to the country at large because the business of making automobiles is our largest industry and therefore has a direct bearing on our future prosperity, has been, and still is, on the lips of millions.

We cannot answer it. Our talks with automobile manufacturers, however, lead us to believe that the industry is entering upon a fairly prosperous year. Replacements alone, as has been so often remarked lately, should account for a very large percentage of the 3,750,000 cars one manufacturer told us the other day would be produced this year. With just a little encouragement in the way of increased business activity, the man who has kept his old car an extra year already, will quickly replace it with a new one. And the same sort of encouragement will tear loose from many people the money they have unwisely hoarded.

If the gods help those who help themselves, the industry should profit this year; for it has certainly helped itself—witness the improvements and developments reviewed elsewhere in this issue. As a result of the industry's desire to make a better car, the pre-war dollar which is worth only 66 cents in the purchase of certain commodities, is worth $1.40 in the car market. Besides this, we are told by an automobile manufacturer, the slack business period has enabled manufacturers to reorganize their plants for more economical production. It seems reasonable to believe that the greater economy will rapidly be reflected in still better cars for the same money or lower prices for present productions. Indeed, a number of manufacturers have already announced reductions in prices.

No, we do not know what will happen to the automobile industry in 1931; but if people show a reasonable amount of common sense in spending—not hoarding—their money, we venture the prediction that it will enjoy a banner year.

On the whole, the outlook is quite hopeful.

Highway Safety

ONE cannot read the newspapers nor ride on the highways in any section of the United States without being appalled at the rapidly increasing number of automobile accidents, particularly those with fatal results. Just where to place the blame for this condition is difficult to determine, because of the many factors involved. There is, however, one phase of the situation that we desire to bring to the attention of motor car drivers, highway engineers, state legislators, and law enforcement officers alike. This is the number of head-on collisions on "super" highways of the east which, in the main, are constructed for three lanes of traffic.

BUSY PLANTS

"WE will keep our plants in operation until spring no matter how bad conditions may be," said M. E. Coyle, vice president and general auditor of the Chevrolet Motor Company, in announcing that his company would guarantee jobs for at least 30,000 men. "Our plan to improve conditions," he continued, "is an eight-hour day and a four-day week. If our employment reaches 40,000 we will increase the working hours to 50 a week." To carry out this plan, the company will underwrite the sale of their cars, according to Mr. Coyle.

We have heard of many plans to remedy the unemployment situation and aid business recovery, but previously none so deserving of unstinted praise as this. To our knowledge it is the finest, most humanitarian move that has been taken since the beginning of the depression. It will mean work not only for 30,000 or 40,000 in the Chevrolet plants, but also for as many more who must produce materials which will go into the cars, and for thousands of others indirectly.

What difference does it make if, ultimately, the increased buying power of these workers results in the sale of more of the company's cars? The thing that counts is that, right now, thousands of families are given the means of clothing and feeding themselves, and, furthermore, business recovery will be stimulated in a big way.

At frequent intervals neat signs sound the warning "Keep to the Right. Center Lane for Passing Only." And in theory, the system works. But then that variable and unpredictable factor of human element enters the picture and the trouble begins. There being, theoretically, only one lane for traffic in each direction, trucks and other slow-moving vehicles hold up the faster cars. Each driver who wishes to pass the car ahead assumes that he has the right-of-way in the center lane, as does also the passing driver coming in the opposite direction. The wrecker and ambulance remove the obstructions to traffic and the stage is set for the next accident.

Consider on the other hand the two- and the four-lane highways. On the former, the driver knows that he has no right-of-way over oncoming traffic when he desires to pass, and therefore he exercises a certain amount of caution before he slips out of line. On the four-lane road, slow moving traffic keeps to the right-hand lane and faster vehicles travel down a clear stretch at reasonable speed. Here the desire to pass the driver ahead is greatly lessened by the fact that he also is traveling at a fair rate of speed. If he is not, at a horn signal he will usually move over to the right-hand lane.

Of course many three-lane roads have been constructed and it is absurd from a financial standpoint to expect that they will be rebuilt. However, before more of them are planned the matter should be given far more careful study. And in the meantime, more attention should be paid to the patrolling of the three-lane highways. It is quite possible that on these roads in stretches of open country a minimum speed limit, enforced, will do much to overcome the tendency for drivers to desire to travel faster than the man ahead, and thus automatically in many cases eliminate the cause of accidents.

International Affairs

Our New Naval Program

THE President has submitted to the Congress the construction program for the Navy during the coming fiscal year, embracing a total of 18 vessels to be laid down between July 1, 1931 and July 1, 1932. These vessels are divided into the following classes:

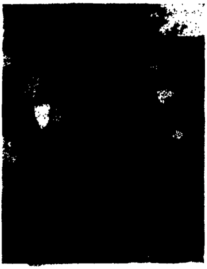
1 airplane carrier, 13,800 tons, to carry 114 planes.

1 flying-deck cruiser, 10,000 tons, six-inch guns, to carry 36 planes.

(*Please turn to page* 135)

AUTOMOBILES FOR 1931 IN REVIEW

BECAUSE the automobile industry gives employment to one out of every ten persons in this country, directly or indirectly, and because it is the largest industry in the country, attention will be more closely focused on it during the coming months of recuperation from depression than ever before. Many important things have taken place in the industry and it is felt that they will influence American life greatly. There have been price cuts, radical changes in body designs, and introduction of mechanical improvements and innovations to satisfy the increasing demand for both swank and transportation.

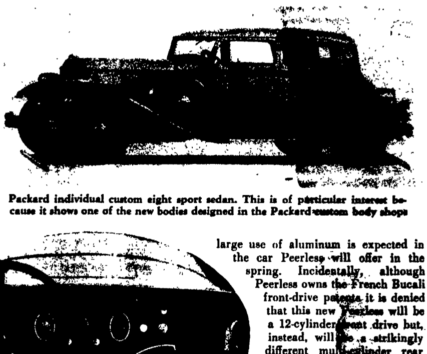

Front view of the new Lincoln. A new painted radiator is featured

The de luxe phaeton, a relatively new Ford model, is distinguished by its low, rakish “[illegible] a single door on each side, and genuine leather upholstery

GREAT progress made in steel and aluminum fabrication during recent years is responsible for the better bodies that will be seen on 1931 cars. There will be less drumming, fewer squeaks and extraneous noises. New methods of attachment and suspension of bodies, lowering of the center of gravity by an increasing use of the drop-frame construction and the joining of constituent sections into rigid bodies have made this possible. Steel all-welded bodies have been introduced for the first time by Chrysler and it is reported on reliable authority that Durant will adopt the frameless all-metal body construction pioneered successfully in Europe by Viscaya.

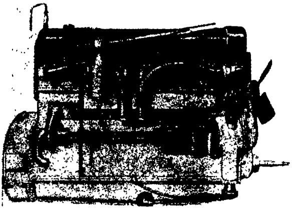
As a rule, car bodies are lower this year but so far not one has been able to compete with the Cord in this respect. Many of the new cars have longer hoods, this effect being achieved by making the front compartment resemble an airplane cockpit. More elaborate bracing and the increased use of sound-deadening material represent the efforts of those progressive manufacturers who build automobile bodies of steel and wood.

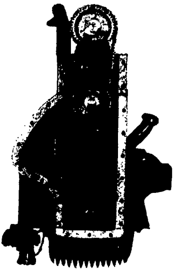
Saving of weight is another item that is becoming increasingly important not only in the body but in the engine and accessories. For example an unusually large use of aluminum is expected in the car Peerless will offer in the spring. Incidentally, although Peerless owns the French Bucali front-drive patents it is denied that this new Peerless will be a 12-cylinder front drive but, instead, will be a strikingly different multi-cylinder rear drive.


Packard individual custom eight sport sedan. This is of particular interest because it shows one of the new bodies designed in the Packard custom body shops

Instrument board of the new Packard, evidence of the attention that has been given to details of this car

Again this year there is a strong trend toward eights to replace six-cylinder cars. Buick, in fact, has entirely abandoned the six-cylinder engine in favor of the eight. Marmon is producing a sixteen-cylinder car for the first time and Cadillac a twelve to supplement its line of sixteens announced in January 1930, and its eights. It is said that still another sixteen is to be announced about the time of the New York Automobile Show by a manufacturer who has hitherto never touched the high-priced car field. At this writing no details are available.

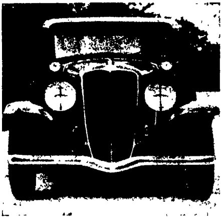




Above: The Stutz silent timing chain which not only operates the overhead cam-shaft but also turns the fan. *Left:* Right side of engine

With increased numbers of cylinders has come increased horsepower, both rated and developed. Also greate piston displacement i noticeable in some of the new models and greater horsepower is developed by improved engines in many cars. Piston displacements of the larger Packard and of the Chrysler Imperial closely approach 400 cubic inches, with 384.8 cubic inches each. In line with the increases in horsepower and displacement many cars have lengthened wheelbases. The Cadillac V-16 leads in this respect with a wheelbase of 148 inches while the Packard eight is a close second with 145½ inches.

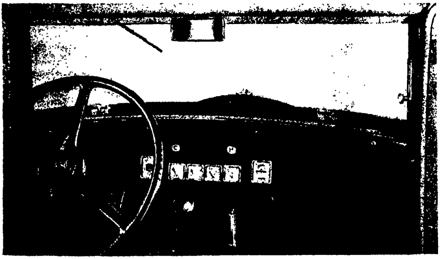
Transmissions have been greatly improved this year. The synchro-mesh transmission, first introduced on the Cadillac and LaSalle lines, is now to be found on the Buick line with the exception of the 8-50 and on a number of others that will be discussed later. In this transmission, designed to correct the clashing of gears and thus add to pleasurable driving, there is a clutch which operates as a synchronizer of any two sets of gears that are to be enmeshed. Another radical change in transmissions is the free-wheeling feature introduced in 1930 for the first time on an American car by Studebaker. This free-wheeling transmission has been added to the 1931 Lincolns and Pierce-Arrows.



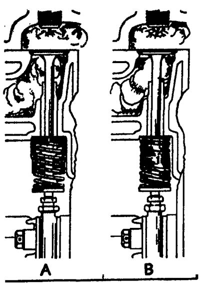
At left: Front compartment of the new Auburn 8-98 brougham showing aviation type instruments. *At right:* Head-on view of the same car showing the distinctive design

Dual and down-draft carbureters are on the increase and several cars have developed special intake manifolds and fuel systems.

Traditionally conservative in several respects, Lincoln this year has changed considerably. First of all, the manufacturer took a radical step forward in adopting the free-wheeling transmission. This device is a small revolving unit mounted on the transmission shaft. It consists of two members, one within the other. The inner member slides on the transmission shaft while the outer



Dodge Brothers eight i board (*left*) and the thermostatically controlled water-cooling system



The Studebaker valve spring damper at left and the carbureter silencer at right. In the former, A shows spring action with damper and B without damper

member connects through the gears with the drive shaft. Between the two are eight rollers, each set in a wedge-shaped slot. When the speed of the motor equals or tends to exceed that of the car the torque of the engine wedges these rollers between the inner member and the outer member, transmitting power to the drive shaft through the over-running clutch. Upon deceleration, however, or when the car speed exceeds the engine speed, the connection through the over-running clutch is broken and the engine slows at once to idling speed. Provision is made for neutralizing the over-running clutch when it is desirable to utilize the braking effect of the engine in descending sharp grades.

In body design, the Lincoln follows somewhat the trend toward lower, longer bodies, its wheelbase being 145 inches, or nine inches longer than the previous Lincoln. With the added length and the lower body, pointed radiator shell, and slanting windshield, the car has a fleeter appearance. The lower bodies were made possible by hanging them on brackets on the outside of the frame instead of on top of it, and be- e of a one-inch decrease in diameter of tires.

The re-designed engine of the Lincoln is of the eight-cylinder "V" type, and is rated at 120 horsepower compared to 90 horsepower in the old Lincoln. It has a carbureter of the down-draft, double-throat type, a fuel pump, and a combination air cleaner and silencer which is attached to the carbureter intake.

To the Ford line there have been added the new de luxe models, the Victoria and the two-door sport phaeton. The distinctive Victoria, which is mounted on the standard model-A chassis, seats four passengers. Mechanically the entire line of Fords is fundamentally the same as that of 1930.

PACKARD'S new cars are presented in two groups, the standard and de luxe models, in each of which there are 11 cars. The newcomers retain the characteristic Packard appearance, but despite improvements that have been made, the de luxe models are priced at approximately 1000 dollars less than the former de luxe cars. Announcement of the new cars also discloses the fact that Packard has expanded body building within its own factories to include a plant for manufacturing custom bodies formerly supplied by custom body builders. This marks an entirely new departure in the industry.

The Packard engine has been given more power principally by means of a new system of intake and exhaust manifolding. A new type of vibration damper lends further smoothness to the engine. Gasoline is conveyed to the carbureter by a mechanically driven fuel pump equipped with a strainer and sediment bowl. The four-speed transmission adopted a year ago has been further refined. Motor exhaust noise is reduced materially by an expansion chamber that has been added to the exhaust line to the rear of the muffler. Among the many other important mechanical refinements of the new Packard is an improved chassis lubricating system. The system which was adopted some time ago to oil all moving chassis joints by pulling a handle under the instrument board now operates automatically through vacuum from the motor.

Low center of gravity with its attendant safety, comfort, and riding ease is an outstanding characteristic of the new Stutz cars. This is obtained through the continued use of the worm drive rear axle in conjunction with the double-drop frame. An exceptionally low car without sacrifice of road clearance or head room is therefore possible.

In its efforts to build safety into its cars, Stutz has adopted steel running boards which are said to be, in effect, side bumpers. The first to use safety, non-shatterable glass, Stutz this year is using laminated glass of "plate" quality. Numerous general body i have been introduced. Bodies are more strongly braced; body framing has been

Aluminum alloy cylinder block of the new Marmon Sixteen-cylinder car

Phantom view of a Chrysler eight showing the double-drop frame. This is similar to the frame which is used by many cars this year and is rapidly coming into general use. *At right:* A Chrysler Imperial cou

given more attention; and a greater quantity of anti-squeak material has been used.

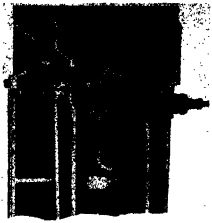
A brake booster is standard on all Stutz models, so that the hydraulic brakes are operated by only a slight touch. The four-speed transmission has been retained in a redesigned form for greater ease of operation. Among other improvements are dual ignition, in which two spark plugs in each cylinder fire simultaneously, and dual carburetion and manifolding.

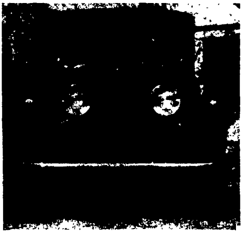
The Gardner Motor Company, Inc. has just announced an improved line of straight eights known as model "148" which comprises five body styles. Style is the keynote in these new offerings but from a mechanical standpoint they are basically the same as the company's 1930 line. Several mechanical changes, however, materially increase riding and driving comfort. These include rubber motor mounting, noiseless rubber-mounted spring shackles, and the four-speed transmission.

Duesenberg was represented by 12 cars at the salons and while several of the designs were of a more conservative type following the general lines of c om coach work, the majority of them were individual and unique.

The Cord front-drive which in the space of little over year has achieved notable success for this revolutionary type, was shown in three custom models at the salon. Mechanically the Cord is practically the same as when described in our January, 1930, issue.

Comfort, spacious interiors, increased power, and quietness are characteristics of the totally new line of cars by Auburn. In general, the bodies introduce a new motif in automobile design, and in their construction, scores of innovations have been introduced to add to the beauty, strength, and rigidity, and to decrease weight. Cars of the new line have a wheelbase of 127 inches and are lower because of the underslung front springs, double-drop frame construction, and the decreased wheel diameter. The rear-axle tread has been increased to 61 inches compared to the average car's 58.


Combustion chamber and twin-ignition system of the new Nash models


Distinctive front view of the Oakland eight

Duplex down-draft carbureter with air cleaner and crankcase ventilating intake tubes on the Marmon 16

The Lycoming engine in the Auburn has been given increased power. The cylinder block has been redesigned to provide more water space around the valves for better cooling. A new single plane, tube type, Schebler carbureter is used, and a suction control economizer has been introduced to make possible more rapid acceleration in the low-speed range. Other improvements have been made to insure easier starting, especially in cold weather, and to minimize the [illegible] of flooding t[illegible]

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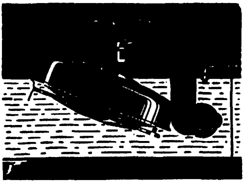
pared to 15 to 25 parts for most others. Brakes are steel-draulic, self-energizing, and require light pedal effort. One other innovation stands out from the scores on the "8-98" Auburn. This is the Bijur chassis lubricating system which operates automatically through the vacuum in the intake manifold. This operates at regular intervals and reaches 12 points on the spring shackles, two on the front king pins, and one on the clutch throw-out bearing.


The Willys Float-O oil device

No very great changes have been made in the Plymouth but in line with the general trend, brake horsepower of the engine has been increased from 45 to 48. This has been made possible by increasing the size of the inlet valves, increasing the lift of the camshaft and of the intake manifold, and by improving carbureter calibration. The vane type of oil pump has been replaced by

(*Please turn to page* 136)

Reo makes its début for 1931 in improved dress

REFINING PLUTO'S ORBIT

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

PLUTO continues to figure in the astronomical news, and with good reason. By the generosity of Dr. S. B. Nicholson of the Mount Wilson Observatory the writer is permitted the privilege of telling *here* of some of his results which will be presented at the scientific meetings later in the present month. Dr. Nicholson, the discoverer of the ninth satellite of Jupiter, and Mr. Mayall have been at work upon Pluto since its discovery was announced. They discovered the faint images of the Planet on the plates taken in 1919, which have been of so much importance in determining its orbit, and computed the first accurate orbit from these.

Now, utilizing the numerous observations of the spring and autumn of 1930 and the pre-discovery photographic positions of 1927, 1921, and 1919, they have completed a very accurate calculation which should leave but a small margin of outstanding uncertainty. These agree so closely with the elements derived by Bower and Whipple at Berkeley, which form the basis of the article which appeared in the December number, that the differences would be practically imperceptible in the diagrams which were there given. Small as the differences are, however, they are interesting, for they illustrate still more of the rather entertaining complications which the calculator has to face.

THE planets as well as the sun are attracting Pluto. In preliminary computations for this or any other planet this influence is simply ignored, but enough is known about the planet's motion now to justify and indeed to demand some better procedure. There are, however, several ways of doing this. In the first place, since all the planets are inside Pluto's orbit, they are attracting it roughly in the same direction as the sun and we may take account of this roughly by assuming that they are all lumped with the sun itself, adding their masses to the sun's. This is what Bower and Whipple did and it was altogether the correct procedure at that stage of the work when the real period and the form of the orbit were still considerably uncertain.

After a good first orbit was available the way was open to calculate by well known though laborious methods just what the attraction of the planets upon Pluto was year by year and how much it altered the planet's motion. But here we must ask a new question. What do we mean by the "unaltered" motion? Pluto has never moved in an "unaltered" orbit and to define one we must get rid of the other planets and their action by some imaginary process and then calculate how much the planet's position in its real orbit differs from that which it would have had under the simpler conditions which we have invented.

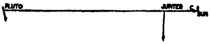
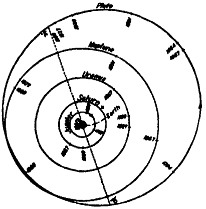


Figure 1

The standard way of doing this is to suppose that at a given instant all the planets were annihilated, leaving Pluto and the sun alone in the system but with exactly the same mutual distance and relative motion. After this imaginary catastrophe Pluto's orbit would be an exact and unchangeable ellipse and its motion could be easily computed. With this as a standard it is then possible to work out just how far the real planet will deviate at any other time from the position which it would have had under the fictitious but simply calculable conditions. At the moment of our supposititious change the position and velocity of the planet are exactly the same in the two systems, hence the real and artificially simplified orbit run very close together in the neighborhood of this time—which, by the way, is called the "epoch of osculation" (the word is borrowed from the mathematicians, who have long employed it to describe a close type of contact between two curves!).



Pluto's orbit drawn to scale with the orbits of the other planets. Reproduced from *Leaflet* 30 of the Astronomical Society of the Pacific by Dr. F. C. Leonard, this drawing was adapted from a diagram made by Mr. F. L. Whipple. Since it was issued in August, it was based on earlier data than the author's diagrams and differs very slightly

But other simplifications of the solar system can be imagined. For example one might suppose that at a given instant the planets were not annihilated but were combined with the sun into a single mass. The best point at which to put this mass is obviously at the center of gravity of the whole system and not the one where the sun's center happens to be. Taking the surviving planet's motion about the now increased attracting mass, we derive another idealized orbit known as the "barycentric" orbit (about the center of gravity) instead of the previous heliocentric orbit (about the sun as attracting center).

EACH of these processes is mathematically quite legitimate, provided that it is clearly explained [illegible] sis has been adopted. [illegible] will never agree, for the [illegible] tracting mass differs and so does the planet's position and motion at the given time. Which one will give the better idea of the planet's subsequent motion? This depends on where the planet is in the solar system. For the earth, or for an asteroid like Eros whose orbit lies *far inside* those of Jupiter and Saturn, the heliocentric orbit will evidently be the best, because these planets tend on the average, though not always, to pull the asteroid away from the sun and their influence could be better represented by diminishing the sun's mass than by increasing it. But for Pluto the reverse is the case and the barycentric orbit is to be preferred.

The differences between the two are far from negligible, the greatest discrepancy being in the period, for which Nicholson and Mayall find 249.20 years in the heliocentric orbit and 247.69 in the barycentric. These differ by one part in 164—a surprisingly large amount at first sight. The perplexity grows when one realizes that by Kepler's laws an increase in the attracting mass of 1 percent will, other things being equal, decrease the period by ½ of 1 percent.

The combined mass of the planets is about 1/700th that of the sun and we should therefore expect the barycentric period to be shorter by 1/1400th part, or two months instead of 18.

BUT the principal difference between our two hypotheses is not that we have altered the *magnitude* of the attracting mass but that we have changed its *motion*. At the epoch of osculation of the orbit (1930) Jupiter was almost in line between Pluto and the sun. It was moving in the same direction as Pluto (Figure 1) while the sun, which lies on the opposite side of the center of gravity C, must therefore have been moving in the opposite direction. The motion of Pluto relative to the sun was therefore more rapid than its motion relative to the center of gravity. Now a more rapid motion at a given point in the orbit implies a larger orbit—so much so that it takes longer than before to make the whole circuit. Hence the heliocentric period should be the longer. We can easily figure out how much. The average orbital velocity of Jupiter is 2.76 times more rapid than Pluto's, the sun is 1047 times more massive than Jupiter, and so its velocity about the center of gravity is proportionately slower or 1/380th of Pluto's. Hence the change in our scheme of reference speeds up Pluto by one part in 380.

Now it follows from Kepler's laws that an increase in orbital speed by 1 percent (in a nearly circular orbit) will increase the period by 3 percent. Hence we should expect the heliocentric period of Pluto to be longer than the other by 3/380ths of its amount, or 1.96 years. This is almost six months more than the actual computations give.

But we have so far taken account only of the influence of Jupiter. Saturn in 1930 was on the opposite side of the sun and acted in the opposite direction and almost to the maximum possible amount. Owing to its smaller mass and lower orbital velocity its effect is only 22 percent of Jupiter's, and in this case decreases the heliocentric period by 0.44 year. The combined effect is an increase by 1.55 years or, allowing also for the change in the assumed mass, 1.72 years. The difference given by the precise calculations is 1.51 years. It is by no means usual to find a case in which such elementary calculation gives so good an approximation.

FROM what has been said it is clear that if the true orbit of Pluto about the center of gravity of the solar system did not change at all, the orbit calculated by considering the sun alone would sometimes come out with a period more than two years too long and again as much too short.

Even the barycentric orbit is not free from variations. The attraction of the planets and especially of Neptune, which has been fairly near Pluto during the last century, will alter it considerably—though by much less than the amounts just considered. It is possible by much more extensive calculations to get rid of these changes also, and to find a "mean orbit" which gives the true mean value of the period, but the time for this has not yet arrived.

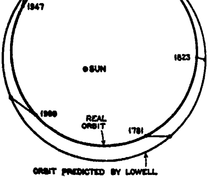
Meanwhile we may note that with the new period of 247.69 years, which should be much nearer the truth than any previous value, is also much nearer to being 1½ times Neptune's period of 164.77 years. After three revolutions of Neptune and two of Pluto the former is only one year's motion ahead instead of four. The interval between the close approaches of the two planets is therefore about four times as long as was previously estimated and probably exceeds 40,000 years, while the last such conjunction happened more than 10,000 years ago.

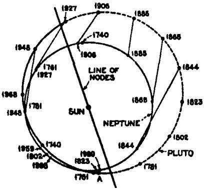
Of wider interest than these calculations is another result which Nicholson and Mayall have reached. They have made the first determination of the mass of Pluto. From the observations of Neptune, proceeding in the usual way, they find that definite evidence of the influence of Pluto's attraction is present, and that its mass is comparable with that of the earth. There is a continuous series of observations of Neptune from the discovery in 1847 to 1930, and two isolated observations in 1795 by Lalande who recorded the planet's position while observing the places of faint stars and supposed it to be only one more of the thousands which he had measured. Observing methods were less precise in those days and this position is less accurate than the others. If it is included in the solution the mass of Pluto comes out 1.08±0.23 times the earth's. If it is excluded the remaining observation give the value 0.72±0.05. The remarkable diminution in the probable error for the second result shows that the later observations are much better represented if the early one is disregarded. Whether so drastic a course is justified cannot be settled till we have a decade or two more of observation or until the perturbations of Uranus by Pluto have been worked up. In any case it is clear that the new planet has a considerable mass and is capable of producing easily perceptible influences on the others by its attraction.

WITH this mass it is probable that its diameter is not very different from the earth's. If so, its apparent disk should be less than 0".5 in diameter. To detect this in so faint an object would tax the powers of the greatest telescopes and demand the very best conditions of seeing which have not yet apparently been available.

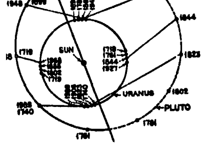
The planet's faintness, too, is no longer seriously puzzling. Pluto reflects a little more light than Mars would do in his place. If his diameter equals the earth's his albedo would be one third that of Mars. This is two fifths the average value for the moon, or about equal to that of the moon's darker area.

So all contradictions vanish and we may welcome Pluto to a fully accredited place among the major planets of our system.—*Mount Wilson Observatory, Dec. 2, 1930.*





The diagrams to which the author refers, reproduced from our December number. At the left is Lowell's predicted orbit of the planet, with the "first approximation" orbit of Pluto based on earlier data. Above is Neptune's orbit with that of Pluto, the dotted part properly being below the plane of the paper. At right are the relative positions of Pluto and Uranus



A WATCH-DOG FOR THE CARBURETER

ON THE afternoon of December 3, last, Captain Frank Hawks arrived in Memphis, Tennessee, after a fast flight from New York in an airplane equipped with the Moto-vita which is described in the accompanying article. Its use, according to the flier, enabled him to reduce gasoline consumption of his engine for the distance flown by 40 percent. The claims made for the device are therefore substantiated by the incontrovertible proof of actual use in a 950-mile flight.

GUESSING the proper fuel-air mixture for an automobile engine may be safe enough as a rule, even though it is a wasteful procedure, but in an airplane it may be dangerous. There is a story told of a well-known army pilot who, on a flight from Long Island to Washington, D. C., very nearly came to grief because of this practice. In order to get the greatest efficiency out of both fuel and motor, he was adjusting the mixture by guesswork when, at about 4500 feet altitude over Baltimore, he thinned his gasoline-air mixture too much and the motor sputtered and died. Since he was not within gliding distance of an airport it was necessary for him to prime his engine and perform the extremely dangerous stunt of diving toward the crowded city in order to start his engine again.

Dr. Miller Reese Hutchison, inventor of the Klaxon horn and former chief engineer and personal representative of Thomas A. Edison, recently perfected a device called the Moto-vita, which eliminates such potentially dangerous and always wasteful guessing in the adjustment of carbureters for gasoline engines. With this device attached to an airplane engine the pilot will have on a small dial before him at all times an accurate analysis of his mixture as shown by the gases passing out of the engine exhaust. He can therefore adjust his carbureter as frequently as changes in altitude and atmospheric conditions demand.

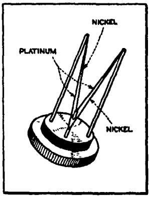
On an automobile the new device would show the driver if his mixture is too lean to enable his car to climb a hill smoothly, or if it is so rich that the exhaust carries an appreciable percentage of carbon monoxide. Elimination of that deadly poisonous gas which is a rapidly increasing menace to public health, is indeed one of the most important jobs of the Moto-vita. It does this by continually keeping watch on the mixture so that the automobile driver can make necessary adjustments.

Neither the driver nor the pilot needs to leave his seat, as the adjustment can be made while the vehicle or plane is in motion; and that adjustment will reduce carbonization of cylinders, fouling of spark plugs, and dilution of lubricating oil, besides the waste of fuel already mentioned, all of which are due to a mixture that is too rich. The fuel-saving feature alone is very important because of the part it may play in this country's oil conservation program.

THE Moto-vita is a small device that is quickly attachable to any existing automobile, bus, truck, airplane, or other vehicle using an internal combustion engine. It is inexpensive, and yet its use increases the cruising radius of a plane or vehicle to as high as one and three quarter times that heretofore attainable with the same amount of fuel. Thus an airplane equipped with it may safely leave behind one third the quantity of gasoline required at present and replace this weight—six pounds per gallon—with pay load. For each 30 gallons of gasoline reduction in fuel load, an additional 170-pound man and his hand luggage may be carried.

The operation of this ingenious invention is based upon catalysis which, for the benefit of those whose knowledge of it may be hazy, is defined as: a chemical change in a compound which is caused by the presence of an agent that remains unchanged.

At the left Dr. Hutchison holds the platinum-nickel unit and its "cage" of woven copper wire. At the right its construction is shown. Below, the inventor explains to a member of our editorial staff how the unit indicates efficiency of combustion when the gases from the exhaust are drawn over it



A fine platinum wire, held in an atmosphere of inflammable gas, is such an agent and is familiar to housewives in the form of a gas-stove lighter, and to some smokers in the form of a patented non-sparking cigar lighter. The former consists of a tiny crimped wire stretched across a loop at the end of a heavier steel wire which serves as a handle. Held in the flowing gas from a gas burner, this crimped wire quickly heats up, begins to glow, and ignites the gas. In this operation, catalysis has taken place; the peculiar reaction between the wire and the fuel has initiated combustion of the latter while the former has undergone no change.

IN developing his new invention, Dr. Hutchison worked from the first on the idea of measuring the percentage of inflammable gases in the exhaust from an internal combustion engine. In endeavoring to find a way to secure proper combustion, he started with the result rather than the cause, for he reasoned that to improve present-day carburetion methods and equipment would be more difficult than to perfect a method of determining continually the efficiency of a carbureter so that it might be instantly adjusted for as high an efficiency as possible. The success he has achieved with his perfected device proves that his reasoning was correct.

When a carbureter is adjusted for too "lean" a mixture, anyone familiar with gasoline engines knows that the engine will sputter and stop as did that of the army pilot's plane previously mentioned. In such a case the combustion of the fuel is complete until the engine actually chokes, and the gas fr [illegible] the exhaust is principally inert, non-inflammable carbon dioxide. On the other hand if the mixture is too "rich" there is more fuel than can be consumed in the limited oxygen supply, the result being that combustion is only partially completed and quantities of inflammable, poisonous carbon monoxide pass out through the exhaust.

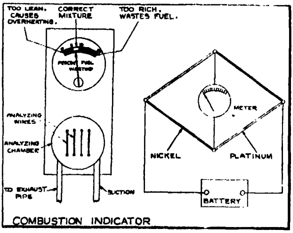
A fine platinum wire in contact with the exhaust gases would, therefore, rapidly heat up because of catalytic action, if those gases contain carbon monoxide. Furthermore, the deg[illegible] of heating of the wire is in propo[illegible] to the percentage of this inflam[illegible]e gas. Working on this basis, it remained for Dr. Hutchison to arrange some method of measuring the temperature rise of the wire. To do this by means of a thermocouple might be possible, of course, but would perhaps be too delicate and complicated.

In elementary electricity, we learned that the resistance of most conductors to the flow of an electric current increases in a certain proportion as the conductor is heated. Dr. Hutchison applied this simple principle to his apparatus in order to show the temperature of his platinum wire at all times.

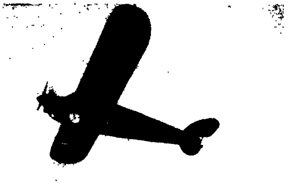
Thus the completed device consists of two fine platinum wires connected in a balanced bridge circuit with two nickel wires, as shown in accompanying illustrations, and a milliammeter which, for the sake of simplicity, is calibrated to indicate not current flow but corresponding degrees of efficiency of combustion. Current from the battery of the vehicle flows through the platinum and nickel wire connection continually and at a definite rate. Gases drawn from the exhaust pipe flow over the platin[illegible] and influence its resistance, the bridge circuit is unbalanced, and the milliammeter is affected accordingly. The carbon monoxide, however, is not ignited because there is no oxygen present.

The airplane pilot or the car driver, by watching the milliammeter mounted conveniently before him, can tell at any instant just how his engine is behaving so far as efficiency of combustion is concerned. All that remains for the pilot to do is to reach forward and operate a small handle, knob, or lever, as the case may be, to "readjust" his fuel-air mixture. The surface vehicle driver will operate a control from his seat which will cause the injection of more air, in case a "rich" mixture is indicated, through an auxiliary air valve on the intake manifold of the engine, this being the only extra equipment necessary.

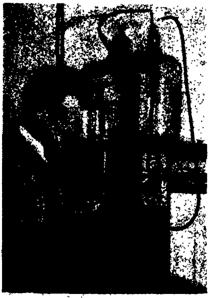
The inventor's eldest son, John C. Hutchison, who is an experienced pilot, has made many test flights using the Moto-vita in the family Fairchild airplane. He watched every drop of gasoline used in the plane and obtained valuable data by calibrating the results with the speed graphs of the engine and the plane.



Schematic diagram of laboratory set-up



The plane in which the Moto-vita has been thoroughly tested and, in the oval, the inventor's pilot son



A test of the invention in the laboratory with chemically made gases

ENGINEERING ASPECTS OF MICHELSON'S VELOCITY-OF-LIGHT EXPERIMENT

By EDGAR C. NICHOLS

Designing Engineer, Department of Instrument Design, Mount Wilson Observatory, Pasadena

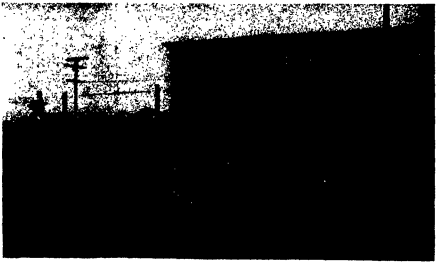
The long vacuum pipe is about 35 miles to the southeast of Los Angeles

PHYSICISTS and astronomers from the time of Galileo have been interested in the determination of the velocity of light. Galileo was probably the first to attempt this measurement but because of lack of equipment he was unable to make a close calculation and decided that light was instantaneous. Foucault was the first to get a practical measurement. He used a rotating multi-sided mirror in his experiments. The most trustworthy measurement we have today is that obtained by Dr. Albert A. Michelson in his famous experiment which he made at the Mount Wilson Observatory in California in 1924. At that time he reflected a beam of light from Mount Wilson to Mount San Antonio, a distance of 22 miles, and back. The velocity then determined was 186,359 miles per second. Dr. Michelson desired to increase the accuracy of this measurement and set up a second series of experiments between Mount Wilson and Mount San Jacinto, a distance of 88 miles. This attempt was not a success because of atmospheric conditions and poor vision.

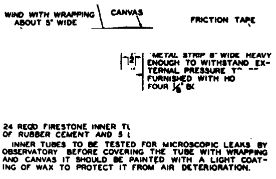
DR. MICHELSON then proposed the idea of measuring the velocity of light in vacuum, a condition which would give perfect seeing and direct accuracy in measuring the distance over which the light beam would travel. (Light travels slightly faster in a vacuum than it does in air.) In the optical set-up which he plans to use, the light from an arc light is reflected from a multi-sided mirror which rotates at a high rate of speed. The revolutions per second of this mirror are determined by a calibrated tuning fork. The mirror with its arc light is to be placed outside the vacuum tube and the light from one of the faces is reflected through a window into the vacuum tube where by a series of mirrors it is reflected back and forth ten times. The light finally passes back through the window of the vacuum tube to the rotating mirror. During the short interval that it has taken the light to travel back and forth, the faces of the rotating mirror have slightly changed their positions and the light that returns is reflected from the face at a slightly different angle than the one at which the light came to it from the original source. This angle, the distance over which the light has traveled, and the speed of the rotating mirror are the three determining factors from which the velocity of light may be calculated.

This optical set-up is particularly adaptable to the use of a pipe line for a vacuum tube. It was decided that a tube three feet in diameter and one mile in length should be used which, because of the reflecting back and forth, would give a total distance of 10 miles traveled by the light. In 1928 experiments were made at the University of Chicago by Mr. Fred Pearson, Dr. Michelson's assistant, to determine the best type and size of pipe to use for the vacuum tube. A pipe combining minimum weight and the strength to resist collapsing pressure was essential. After several tests Armco corrugated pipe of No. 14 gage was found to be perfectly satisfactory. Corrugating a 36-inch pipe of No. 14 gage metal increases the resistance to collapsing pressure 25 times. The factor of safety for a complete vacuum, or an external collapsing pressure of 2100 pounds per square foot, is 10.

IN 1929 and 1930 a vacuum tube was built by the Mount Wilson Observatory on the Irvine Ranch near Santa Ana for Dr. Michelson's experiment. This vacuum tube is slightly over a mile long and consists of ninety 60-foot lengths and two 40-foot lengths of 36-inch diameter corrugated pipe as well as four welded steel "tanks," each six feet long, five feet wide, and five feet high, for housing the mirrors and their mountings. The total volume of the vacuum tube including the mirror tanks is approximately 40,000 cubic feet and the ratio of the enclosing surface to volume is rather high. The tubes and tanks have a surface area of approximately 53,000 square feet and when completely evacuated they resist an external collapsing pressure of 55,000 tons. The area of a sphere necessary to enclose a volume of 40,000 cubic feet would have a diameter of slightly more than 42



Dr. A. A. Michelson giving an explanation of the present experiment before the connected microphone and camera of the Pathé talking motion pictures


WIND WITH WRAPPING ABOUT 5" WIDE
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METAL STRIP 8" WIDE HEAVY ENOUGH TO WITHSTAND EXTERNAL PRESSURE T
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24 REQD FIRESTONE INNER TU
OF RUBBER CEMENT AND 5 L
INNER TUBES TO BE TESTED FOR MICROSCOPIC LEAKS BY OBSERVATORY BEFORE COVERING THE TUBE WITH WRAPPING AND CANVAS IT SHOULD BE PAINTED WITH A LIGHT COATING OF WAX TO PROTECT IT FROM AIR DETERIORATION.

feet with an enclosing surface of approximately 5700 square feet. This gives a ratio of surface of tube to surface of sphere of 9.3 to 1, which gives some idea of the area of tube surface to be made air tight.

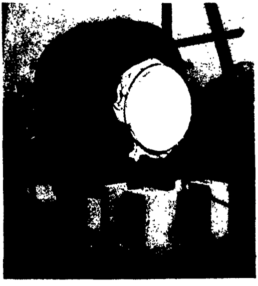
The corrugated pipe was delivered to the site of the experiment, double riveted and soldered, ready for installation. On the pipe alone there were 23,000 feet of soldering, not including rivet heads. When the pipe line was finally evacuated a very small number of leaks was discovered. In constructing the pipe line each individual 60-foot length of pipe was mounted independently on five wooden cradles. A space of one inch was left between pipe ends to allow for expansion. The pipes were sealed together and to the tanks with air-tight joints consisting of iron bands wrapped with canvas, and the whole joint was then enclosed by a band of rubber, made from a standard seven-inch balloon tire inner tube the edges of which were cemented with special rubber body cement to the pipe ends and then wrapped with heavy cord. The entire joint was then painted with Glyptal paint and finally wrapped with an outer covering of waterproof canvas for protection from air and sun. This method of connecting the pipes has proved entirely satisfactory as it has given a flexible as well as an air-tight joint which is not expensive to construct.

AT each end of the pipe line are two of the mirror tanks connected by a 40-foot length of pipe. The tanks are made of 5/16-inch steel plate and are reinforced on the outside with steel channels and I-beams, the whole construction being welded together to ensure an air-tight job. To facilitate the installation of the mirrors and mountings, the tanks were made in two parts. The tank proper is open on the bottom and has an angle running around the lower outside edge. This angle rests upon a flat base plate which is reinforced on the under side with I-beams. The lower edge of the tank is defined on the base plate by a 2 by ¾-inch steel bar extending entirely around the inside of the bottom of the tank. This bar is welded to the base plate and when the tank is evacuated it carries the collapsing load on the lower sides and ends of the tanks. The joint formed by the base plate, steel bar, and the angle make an ideal seal. The joint is filled with Hydroseal, a one-eighth-inch lead wire having been placed in the corner of the joint to keep the Hydroseal from sucking into the tank. No bolts are necessary to fasten the tank to the base plate for they are held together by the external collapsing pressure created by the vacuum. A 29-inch vacuum causes a pressure of about 50,000 pounds, holding the tank and base plate together.

REACTION heads are necessary on the tanks at each end of the pipe line in order to balance the external pressure on these tanks. These reaction heads are of the same area as the 36-inch corrugated pipe and are supported on struts on concrete piers, the thrust being taken care of by rods and turnbuckles connected to "dead men" buried in the ground.

The tanks are supported on concrete piers entirely independent of the mirror mounting supports. The mirror mounting supports are three four-inch diameter steel columns mounted in concrete piers. They extend into the tanks through three sealed joints of five-inch diameter steel tubing welded to the tank base plate. The seal is made with sections of rubber inner tube cemented to the steel columns and five-inch diameter tubing. In the ends of each tank are holes of two-inch diameter covered with glass which has been waxed on with Kotinsky cement. These windows are for the purpose of examining the mirror mountings from the outside.

On the mirror mountings there are 13 small motors and four electric lights for use in adjusting the mirrors. These are operated by remote control. Seven of the motors and four lights are at the north end of the tube and are operated from the main station at the south end of the tube over a mile away. The motors may be run in either direction of rotation and the lights turned on or off. This is accomplished with five wires from the main station. A Selsyn motor and generator are used. The observer, by turning a knob on the generator to the desired position, selects the motor or light which he wishes to operate. The motor a mile away at the north end precisely follows the generator and contacts the desired motor or light. After the motor or light has been so selected it is then operated through a relay by a push button at the main station. By means of relays the lights may be left on as long as desired but the motors will only operate as long as the push button is closed. Because of temperature changes, constant adjustment of the mirrors is necessary during an observation. Manholes with covers and gaskets are provided in each of the 40-foot lengths of pipe at the ends of the pipe line. These are for access to the mirrors and mountings. A vent pipe with valve is provided to relieve any pressure that may be generated by heat when the line is not pumped out.



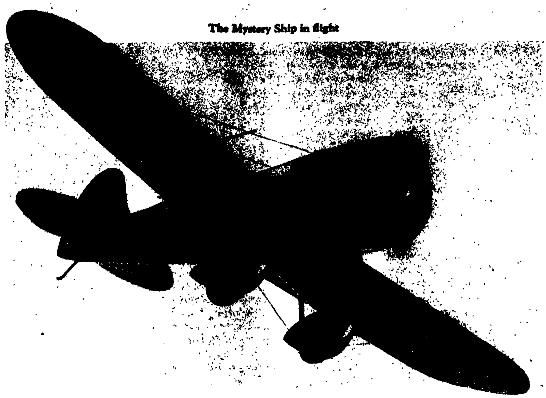
One of the built-up tanks designed to contain the mirrors (described in the text)

EVACUATION is accomplished by two Kinney vacuum pumps with capacity totaling 400 cubic feet of free air per minute. At peak load or 21-inches of vacuum, 20 horsepower is required to operate the pumps. As the vacuum in the tube increases the free air displacement of the pumps decreases and at 29-inch vacuum 12 cubic feet of free air per minute is being removed. In approximately 15 hours of pumping the tube is pumped down to a 29¾-inch vacuum. Besides the vacuum pumps, a motor-generator set is used for operating an arc light for a light source and an air compressor for driving the turbine of the rotating mirror.

●

¶ If the apparatus is ready in time Professor Einstein may co-operate with Professor Michelson on the vacuum experiment. The origin of the Einstein theory itself was one of Michelson's experiments.—*The Editor.*

The Mystery Ship in flight



THE "MYSTERY SHIP" REVEALED

The Fastest Commercial Plane Yet Flown, It Has Out-Performed the Best Planes of the Army and Navy

WHAT is there about the "Mystery" airplane which has made it such a good subject for newspaper copy since it made its first public appearance at the National Air Races of 1929 at Cleveland, piloted by Douglas Davis of Atlanta, Georgia? At that time it was clocked at 228 miles per hour on one lap of a closed course race. Since then in Mystery Ships Lieutenant James H. Doolittle, former army ace, has given some impressive demonstrations, Capain Frank M. Hawks has made a number of records which are detailed later on, and Mrs. Florence Lowe Barnes is setting new world records for women, proving how easily this type of ship can be handled and flown by women as well as men.

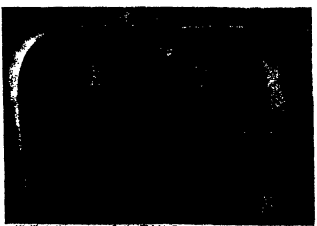
It is now possible to lift the veil of secrecy which has been so carefully wrapped around this plane. The details of its construction are as interesting to the layman as they are of importance to aviation engineers.

To a certain extent airplanes have become conventional in outer appearance. The man in the street is apt to say that all airplanes look alike and it is quite true that all airplanes look alike in that they have the same constituent parts and general arrangements which do not vary widely. The main difference between one airplane and another arises from the greater skill with which aerodynamical, structural, and power-plant elements are combined and in the degree of refined engineering which is put into a design.

Outstanding developments in airplane design still appear from time to time but during the year of 1930 perhaps the most outstanding success was that established by the Travel Air Mystery Ship, which engineers and laymen alike can visualize readily from the accompanying photographs and drawings.

Since its first appearance this ship has defeated the best planes of the Army and Navy, this being the first time that such a performance has been accomplished by a purely commercial plane.

In a little more than a year, the Mystery Ship has not only held its title of being the fastest commercial plane in the air, but it has appeared in all parts of the country and has set up many records, of which one of the most important is the coast-to-coast record by Captain Frank M. Hawks. This flight was made from Glendale Airport, Los Angeles, to Valley Stream, New York, on August 13th, 1930, in an elapsed time of 12 hours, 25 minutes, and 3 seconds, only 11 hours and 40 minutes of which was in the air. Captain Hawks also flew from Boston to New



All illustrations courtesy Curtiss-Wright Corporation

The Venturi cowl is constructed in two sections, shown here opened. The braces and air-deflectors are welded

York on October 7th in 54 minutes 15 seconds; from Philadelphia to New York on Oct. 9th, in 20 minutes; and from Detroit to New York on Sept. 30th, in 2 hours and 41 minutes. Just recently his spectacular flight to Havana again has broken all records.

The Travel Air Low-Wing Model "R," the full designation of the Mystery Ship, has demonstrated that by the use of the supercharger with high compression and speed, the power of the airplane can be considerably boosted with very little additional weight and complication in the power plant. The Wright nine-cylinder 300 horsepower engine was made to develop, with the use of the supercharger, 400 horsepower at 2300 revolutions per minute.

At the front end of the engine will be noticed a so-called Venturi cowl. This had already been found by prior experiment to be a great aid in decreasing resistance and increasing speed.

TWO of the photographs show the Venturi cowl. Cowl, engine, and fuselage blend into one streamline shape, as can be seen from the drawings reproduced on page 98.

The steel tube engine-mount is detachable and carries the engine on a 1¼ by .083-inch ring. The main fuel tank, located in the fuselage, is made of .040-inch aluminum and is supported on the longerons. A five-gallon reserve tank is located behind the main tank and is connected to the main tank only by a wobble pump. The capacity of the main tank is 42 gallons and the feed to the engine is by gravity. One-half inch gas lin throughout the installation.

The Venturi cowling is made of .040-inch aluminum and has no cooling baffles between cylinders. The inner cowling is aluminum of the same thickness and extends back to the cockpit. An oil radiator is mounted in the wing stub and the cooling fins form the walkway. The fire wall is .040-inch aluminum and is located at the front fuselage bulkhead.

An eight-foot diameter Standard steel propeller is used, set at a pitch of 22.6 degrees.

The engine control bracket consisting of throttle, spark, and mixture is located at the pilot's left on the side of the cockpit.

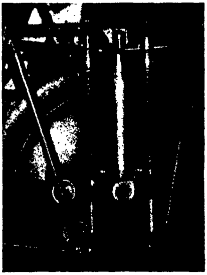
Another photograph shows the covering removed and the engine mounted on its rim. It gives a wonderful idea the complexity of the installation and the attention and care that has to be engine sories, controls, leads, and so on.

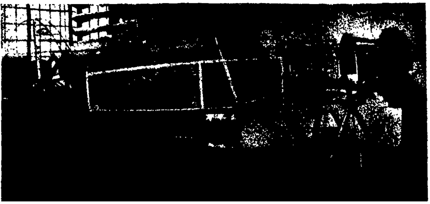
The Venturi cowl assembled

Specifications of the Mystery Ship

Length overall	20 ft. 2 in.
Height overall	7 ft. 9 in.
Airfoil (Wing Section)	R.A.F. 34
Span, each wing	29 ft. 2 in.
Chord, each wing	60 in.
Area of wings, total	125 sq. ft.
Area of ailerons	12.3 sq. ft.
Area of horizontal stabilizer	14.1 sq. ft.
Area of elevators	9.4 sq. ft.
Area of fin	4.1 sq. ft.
Area of rudder	5.7 sq. ft.
Weight empty	1475 lbs.
Disposable load	456 lbs.
Gross weight loaded	1940 lbs.
Power Plant	400 hp at 2300 rpm
Wing loading	15.5 lbs/sq. ft.
Power loading	4.6 lb/hp
High speed (full load, sea level, and in level flight)	235 mph
Cruising speed	150 mph at 1550 rpm
Landing speed	70 mph
Take off run (still air)	300 ft.
Climb at sea level	3200 ft. per min.
Service ceiling	30000 ft.
Absolute ceiling	31000 ft.
Gasoline consumption at cruising speed	13 gal/hr
Gasoline capacity (normal)	47 gal.
Range at cruising speed	525 miles
Endurance at cruising speed	3½ hours

The landing gear is of unusual design. The shock absorbing device, in conformity with Travel Air practice, is a combination oil and coil-spring contrivance. The oil cylinder is used to absorb the initial shock of landing and the spring is used to absorb the shocks of taxying. The method of mounting this shock absorber and of attaching the landing gear to the plane is also unusual. The wings are hinged to wing stubs which project out from the fuselage about 25 inches. The ends of these stubs extend to a point over the wheels. The wheels support the airplane by vertical "N" struts which attach to the ends of the wing stubs. The wheels are braced laterally by streamline wires running to the opposite wing stub. The external wing-bracing wires also are attached to the base of the "N" struts. The shock absorbing device, consisting of two oil cylinders and four coil-springs with the wheel slung between, is located at the


A close-up view of the combination oil-and-spring shock-absorber unit


A view of a partially assembled Mystery Ship showing the uncovered landing gear and the N struts, as well as the method of mounting the motor on a ring

bottom of the "N" strut. The wheel and all the mechanism are enclosed in a streamline cover of .040-inch aluminum.

The extremely short tail skid is fitted with a shoe and is streamlined. An oil-and-spring shock absorber is fitted to the upper end of the tail skid beam which is hinged to the lower member of a bulkhead. The thrust line makes an angle of 13 degrees with the horizontal when the tail skid is on the ground.

The wing is one of constant center of pressure, the center of gravity being set far forward at 24 percent of the chord so as to give maximum stability. The gas tank is located exactly on this center of gravity and as the gasoline constitutes nearly all the variable load, the trim of the ship is constant.

Tapered in plan form and thickness from the wire point out, the airfoil section is R. A. F. No. 34. Its maximum ratio of lift to drag is 20.6 and the bracing is by streamline wires to the landing gear and to the cabane which is concealed under the cowling. Spruce and Haskelite three-ply one sixteenth inch mahogany plywood are used in constructing the plywood-covered wing, and the spars are built up of two spruce beams glued together and not routed. Fittings are all enclosed and are of chrome molybdenum steel. The compression ribs are built of spruce trussing boxed with plywood webs, nailed and glued in place on spars with angle blocks. The normal ribs are spruce trussed and have mahogany plywood gussets. Tie rods form the drag bracing in addition to the plywood covering which makes the wing extremely rigid. The leading edge is covered with two-inch tape to keep the plywood from breaking out over the bend. The trailing edge is of spruce. The ailerons are attached to a false spar by three inset hinges.

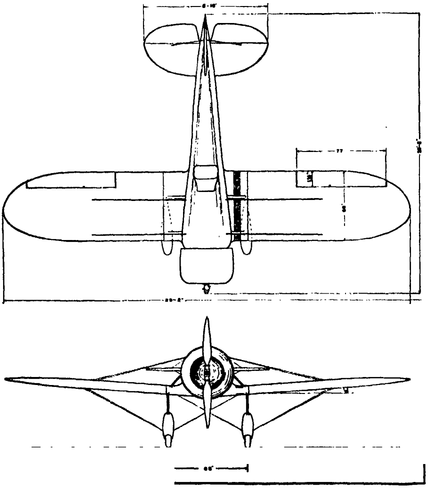
The welded steel tube used entirely in the fuselage is wedge-shaped to provide ample room and yet to be as economical of frontal area as possible, and is faired out to a well-rounded cross-section. The fairing and turtle deck are of spruce superstructure covered with mahogany plywood one sixteenth inch thick. The structure is tube braced throughout, and the longerons are made of ⅞ by .035 and 1 by .049-inch chrome molybdenum steel.

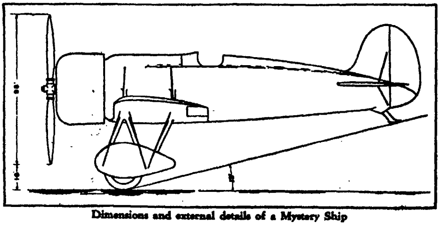
Ailerons are fabric-covered chrome molybdenum steel construction while the stabilizer is built of steel tube spars and stamped steel ribs. Elevator, fin, and rudder are of similar construction and all are fabric covered. The steel torque tube is operated by a differential push-and-pull tube system, and cable control is used for both rudder and elevators. The stabilizer is adjustable in the air and the fin is adjustable on the ground, while the elevator control linkage gives a differential action.

ANOTHER outstanding feature of this design is the very low power loading of only 4.6 pounds per horsepower. In the average automobile, the power loading is more likely to be something like 30 or 40 pounds per horsepower.

To get the speed and maneuverability very high load factors are compared: If the wing is at high angle of incidence, the airplane can stand 12 times its normal weight before breaking up. In a nose dive it can stand over four times its normal weight and in inverted flight it has the same factor. The horizontal control surfaces can withstand a load of 50 pounds per square foot and the vertical control surfaces can withstand a load of 37.5 pounds per square foot by actual test.

After considering all these engineering refinements one well may wonder wherein lies the value of building these exceptionally fast and high powered airplanes. The answer is that fast, record-making machines are the precursors of the fast commercial airplane of the future; they are test units for development of the science of aeronautics, just as the laboratory is the battleground of industry.





Dimensions and external details of a Mystery Ship

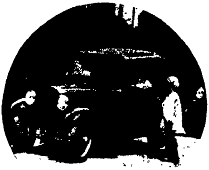
THE BABY OF THEM ALL

SHORTLY after the war the British Government, seeking new sources of revenue, placed a tax of one pound per rated horsepower on motor cars. British manufacturers naturally turned toward small motors, particularly motors with a low rating. The Austin 7 was the outcome of this trend so far as the Austin Company was concerned.

It is claimed that Sir Herbert Austin was the first of the British manufacturers to produce a car of this small size which would perform satisfactorily. Because of the success it has met with in the British Empire, America was considered to be a large potential market and accordingly, in 1930, the American Austin Car Company, Inc., was organized with a factory at Butler, Pennsylvania. Essentially the same as its British parent, the American "Austin antam" presents a redesigned, more raceful body, and is equipped with ertain American parts.

The Austin Bantam has the remarkably short wheelbase of 63 inches, and its total weight is 1100 pounds. It has a four-cylinder, water-cooled, detachable L-head, seven horsepower engine with a 2.2-inch bore and a 3-inch stroke. Other specifications are: Autolite Bendix-drive starter; Autolite lighting and ignition; single plate clutch; transmission, three speeds forward and one re-

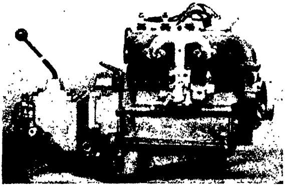
Its low relative center of gravity gives to the Austin great stability



As trim and complete as a large c

verse; four-wheel, inte panding, equalized, and easily adjustable brakes; semi-floating rea and torque tube drive, ratio 5.25 t mi-elliptic transverse springs i t; two quarter-elliptic springs r; disk wheels; and drop center, untable rims. Its oil capacity is five pi and the gasoline tank holds five gallo

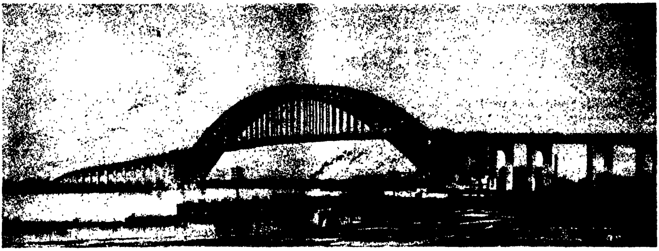
Fuel economy of n Bantam is, without doubt, bett with any other car produce to 45 miles to the gallon of gasoline being the usual figure.



At the left is shown the compact engine which is rated at seven horsepower. Above is an interior view of the car showing the large luggage space behind the seat, and plenty of leg room

In the factory the tiny engines are assembled on a conveyor table which carries them to the general assembly

As the chassis is conveyed along the general assembly line, the motors are fitted and other parts of the car are attached



Beauty in every line. An artist's drawing of the Kill van Kull Bridge

BRIDGING THE KILL VAN KULL

By JOHN F. GALVIN
Chairman, The Port of New York Authority

IN September, 1928, ground was broken for a bridge over the waters of the Kill van Kull between Bayonne, New Jersey, and Port Richmond, Staten Island. A little more than two years later, on October 9, 1930, the great steel arch of this interstate span was joined at the center and the structure became the largest arch bridge in the world.

The arch crossing at Sydney, Australia, which is now in course of completion also, held the distinction and led all others in size for the brief space of two months. The Kill van Kull bridge surpasses the Sydney bridge by a few feet. The span should be at the service of the motoring public early in 1932.

The bridging of the Kill van Kull both for rapid transit and vehicular purposes was contemplated for a generation before it was possible actually to undertake the project. Creation of the Port Authority by treaty between the states of New York and New Jersey, with the approval of Congress, provided the means by which it was finally possible to finance and construct the crossing. The Port Authority is the agency through which the two states co-operate in developing interstate transportation links.

The Legislatures of 1925 and 1926 instructed the Port Authority to inquire into the merits and financial feasibility of uniting the Bayonne peninsula with Staten Island. A report submitted in 1927 contained a series of recommendations which met with approval and led to the passage of supplemental legislation specifically authorizing the Port Authority to proceed with the project.

Following the preparation of preliminary plans and their approval by the War Department in 1927, a 12,000,000-dollar bridge bond issue was sold by the Port Authority on advantageous terms. The two states of New York and New Jersey previously had agreed to advance 2,000,000 dollars each. This money will be repaid with interest out of the bridge revenues and completes the total estimated expense of 16,000,000 dollars. As with all Port Authority undertakings, the Kill van Kull bridge must be self-supporting and tolls, therefore, will be collected from bridge patrons.

A careful survey of traffic requirements was one of the most important phases of the preliminary studies made by the Port Authority. It was found that largely as a result of other transportation improvements, including indirect influences such as the Holland Tunnel and the new Hudson River Bridge, as well as the two Arthur Kill bridges between Staten Island and New Jersey and the proposed tunnel between Staten Island and Brooklyn, that the building of a Kill van Kull link was a vital necessity if the traffic problems of the region were to be successfully solved.

An arm of the arch span reaches out to meet the other half way

THE inquiry into the traffic situation led to an agreement on plans for a four lane roadway 40 feet in width. This, it was felt, would meet the necessities of vehicular traffic for the next 20 or 25 years. At the same time, a decision was reached to provide for a subsequent addition of two lanes.

The need of rapid transit facilities over the Kill van Kull also was investigated. Although such facilities might be extensively patronized by commuters and others traveling between Manhattan and Staten Island by way of the Bayonne peninsula, it was felt that the revenue would be insufficient for some years to come to warrant the extra expense.

It was decided, however, after consultation with the Suburban Transit Engineering Board to build a bridge big enough and strong enough to permit the laying of two rapid transit tracks in some future year, if the latter form of service should then be preferred to an increase in the number of vehicular roadways.

In fixing the exact location of the bridge, the determining factors were the economy of approaches. Topographically, there was little to choose between various available sites. The final plans called for a skew span of greater length than a right-angle crossing. The former fits well into the scheme of highway connections on each side of the river.

The waterborne traffic passing under the bridge was almost as important a consideration as the study of the vehicular traffic that will pass over the bridge. The Kill van Kull is noted for the volume and value of its shipping. It is the main gateway to Newark Bay and the Arthur Kill, and transports an annual tonnage greater than that passing through the Suez Canal.

THE stream is about 1200 feet wide between pierhead lines with a 35-foot channel running close to the Staten Island side; the bridge will have a clear height of 150 feet over the channel with an entirely clear waterway between pierhead lines.

Before selecting the arch design, comprehensive studies were made of other types. The arch design was chosen for both esthetic and economic reasons. It was felt that the arch design was particularly well adapted to the background of the Kill van Kull region. Similarly, the presence of bedrock near the surface, affording a solid foundation to resist the arch thrust, was favorable to the arch design at this location.

The bridge structure is flanked on each side by approaches consisting of steel plate girder spans supported on concrete piers. The Port Richmond approach is approximately 2900 feet in length and the Bayonne approach approximately 3700 feet, making the total length of the structure from plaza to plaza approximately a mile and two thirds. The roadway profile consists principally of straight 4 percent grades, with connecting vertical curves at the ends, and with a hyperbolical curve over the arch structure.

The arch abutments are designed to present a massive appearance for architectural reasons, but are of solid masonry only for sufficient height to support the arch shoes. The upper portions are hollow structures of comparatively inexpensive concrete construction with granite facing.

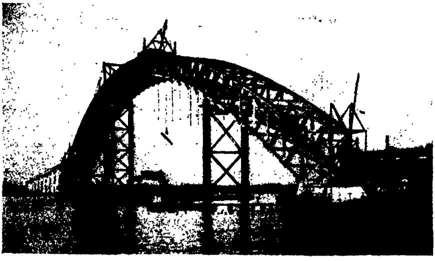
The arch span itself is a parabolic two-hinged steel arch. The bottom chord is the principal arch member, and, at the abutments, supports the entire arch thrust. It is composed entirely of carbon-manganese steel, and has a cross-sectional area of 980 square inches at the abutments, and 580 square inches at the crown.

The hinges are formed by pins 16 inches in diameter, bearing upon heavy steel forgings which insure uniform bearing over the supporting structural steel webs. The arch shoes upon which the lower pin bearings are erected are of riveted structural steel. Each shoe is 10 feet high, 15 by 18 feet at the base, and weighs about 120 tons.

Each of the forged pin bearings weighs about 60 tons. The top chords of the trusses are of silicon steel. The web members of the trusses, and the bracing between the trusses are of carbon steel.

The arch was erected by cantilevering from each side to the connecting point over the channel. Temporary steel piers or bents, made up largely of material which will be used later for the bridge deck and the approaches, supported the arch trusses at certain points as the erection proceeded. Four such bents were used for the south arm and six for the north arm of the arch.

Hydraulic jacks, installed on alternate bents, raised the arch from the preceding bent and then lowered it to full bearing on the succeeding bent, as erection proceeded, each bent being wholly unloaded as soon as erection had advanced to the succeeding bent. Each jack had a capacity of more than 3500 tons. The south arm of the arch was erected to the connecting point over the channel before erection of the north arm was commenced.



The great steel arch is joined in the center to form the longest arch span in the world. On this side may be seen one of the great girders of the floor support

THE approach piers are of reinforced concrete, varying in height from 20 to 110 feet above the surface of the ground. The lower piers consist, in general, of two independent hollow shafts. The higher piers consist of two hollow shafts connected at the top by an arch. The principal reinforcement is a structural steel frame, composed of angles with bolted connections, embedded in each pier.

These structural frames furnished means for holding the forms in place as well as forming rigid reinforcement for the concrete. In addition to the frames, "surface reinforcement" by steel rods was used near the exterior surfaces.

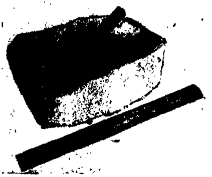
Because of the great size of this bridge, and in order to check the theoretical stress investigations, it was considered advisable to construct a test model of the arch span and subject it to loading simulating that which will come upon the completed bridge. The model was constructed with all the arch members made of engravers' brass, a material of very uniform quality. It was built to a scale of 1/16 inch to a foot, making a convenient length of about nine feet for the arch model.

MORE EVIDENCE OF THE "FOLSOM CULTURE" RACE

By **HAROLD J. COOK**

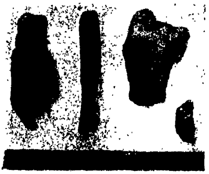
READERS of the SCIENTIFIC AMERICAN may recall an article which appeared in the number for July, 1928, describing an important discovery of skilfully made arrow points of a new type called "Folsom Culture" points, in association with skeletons of a large prehistoric species of bison, near Folsom in the northeastern corner of New Mexico. Since that date much work has been done both in that locality and also in surrounding and adjoining territory, in an attempt to learn more about the remarkable race which was responsible for these evidences, a race which must have antedated the cliff dwellers and pueblo builders and other American Indians, yet was far more skilled than they in the art of flint chipping—skilled to a degree barely equalled by the finest Neolithic flint workers of ancient Egypt and Norway.

Above: Mr. Perry Anderson, co-discoverer of the site, pointing with his cane to the flint point mentioned in the article. *Below:* The point in its original block (note sand-blasted surface) encased in burlap and plaster cinches



A joint expedition of the Colorado Museum of Natural History (Denver) and the American Museum of Natural History (New York) has completed excavations started two years previously by the Colorado Museum, with the result that 17 of these skilfully made arrow points were recovered in the same layer associated with the skeletons of more than 30 individuals of the extinct *Bison taylori*, an animal one third larger than the existing modern bison. There is some difference of opinion as to whether these peculiarly shaped points, characterized by a long concave flake taken out lengthwise from both sides and a back end with "rabbit ears," in reality were arrow points, dart ("atlatl") points, or spear points, but in any case their general purpose was the same.

SOME time ago Dr. A. E. Jenks, head of the Department of Anthropology at Minnesota University, Minneapolis, examined a new location in Yuma County, northeastern Colorado, which had been found and reported by Messrs. Perry and Harold Anderson of Yuma, Colorado. Professor Jenks reported to the writer evidences of apparent geological antiquity for the occurrence of certain remarkable pieces of flint chipping, apparently found in association with fossil bison and fossil mammoth bone, some of which he turned over to the writer for identification, urging that we examine the place immediately. Press of other matters, however, prevented this until 1929, when the writer, with Mr. Nelson Vaughan of the Museum staff as an assistant, visited the locality.

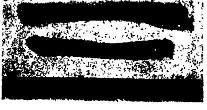


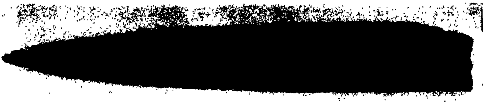
Above: Broken fossil mammoth bones showing cutting and abrasion marks made when the bones were "green". *Right:* Fossil bison bones bearing artificial abrasion marks and cuts along their faces

Here the Messrs. Anderson offered us every kindness and all possible aid, taking us to the site of their several discoveries and showing us their large and interesting collections. They deserve great credit for recognizing and bringing to light on their own initiative and at their own expense important new evidence, and working on it at every possible opportunity. The discovery of these artifacts adds another strong link to the chain of accumulating evidence that ancient man lived in America, and throws new light on the antiquity of the "Folsom Culture" described in the former article.

The region is one of the last in which a trained collector would expect to locate such evidence. Situated on the higher part of the watershed between stream valleys of northeastern Colorado, the surface of the area is mostly shifting dune sands, and high, dry, sod-covered grass lands, far from water. No natural exposures of rocks or other old formations are to be seen, a most unpromising combination of conditions. However, a few years ago during a land boom most of the area was homesteaded and many plots of ground were plowed up, varying in size from a few to many acres in extent.

WHERE the plow destroyed the natural grass sod, the prevailing strong winds quickly started the process of removing the light sandy soil, forming "blow-outs" as large as each plowed field. These field-sized pits were deepened by the wind until they reached the deeper formations, exposing these over large areas. Excavation to secure road surfacing materials further deepened a few spots, and exposed a still deeper and more complete section. The deepest beds exposed here are heavy deposits of coarse sands and granitic gravels, evidently old flood plain deposits, and probably of Pleistocene (ice) age, made at a time when the wide plains of



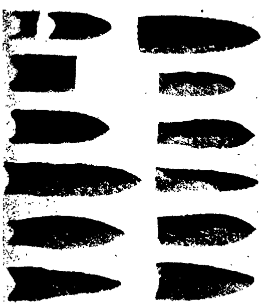


One of the finest pieces of stone chipping found in America. The Andersons found several points of this remarkably refined, delicate type in these old beds. Reproduced at natural size

eastern Colorado still were being built up, and before erosion initiated the present drainage system of valleys. Undoubtedly this was coincident with one of the exceedingly wet cycles which occurred intermittently as a result of the melting of the great ice sheets nearby.

These gravels are many feet in depth and of unknown thickness. On top of and in contact with them is a greyish colored bed a few feet thick, containing an abundance of silt and lime, fossil bones, shells, and human artifacts. This bed evidently represents the final stages of the flood plain deposits, when the climate turned more dry, and sluggish pools were formed and existed for a time. Then the region dried up, and a prairie soil and sod was formed, a little above the greyish bed. On this were deposited wind-blown sands, and this in turn had been nearly all sodded over in still more recent times, due to a temporarily increased rainfall, previous to the advent of the plow.

From all this it readily will be seen that the grey bed or level containing fossils and artifacts has much antiquity. Not enough study has been done here as yet to date the deposits accurately, but preliminary work indicates a late Pleistocene date, and at the latest, not more recent than immediately post-Pleistocene; that is, in the time immediately following the recession of the last great ice sheet from the north.



Fifteen chalcedony, jasper, flint and quartzite points found by the Andersons at the Colorado site, showing some of the diversity of types in the ancient silt bed. At the upper left are typical Folsom points and the others are modifications of this form. Reproduced at about one third natural size. The Folsom type of workmanship is distinctly finer than the other types found in America. Especially after handling them one derives the impression that they must have been made by "specialists" as skillful as any civilized toolmakers

In the first blow-out to which the Andersons took us we found scattered fossil bones and flint chippings in the partly eroded surface of the old grey bed. In the second hole, good fortune smiled on us and I had the rare good luck to find, in position and undisturbed, half buried and half exposed by erosion in this grey bed, a large and splendidly wrought flint point. This was first photographed in place just as the wind "sand blasts" had half excavated it. Then it was taken up intact in a block of the matrix, for permanent exhibition in the Colorado Museum of Natural History, in Denver.

Further good luck attended us here. A few yards to one side in this bed a fossil bison bone also was found, half buried and half exposed by the cutting of wind-driven sands. This bone shows numerous marks of the type so characteristic of bones used as flaking tools by early races of men. It almost surely was used as such a tool. A short distance away on the other side, a number of broken bones of a mammoth which had previously been located by the Andersons, were found in the same bed. A close examination of these disclosed many cutting and grooving marks, so identical with those found on other bones both in America and in prehistoric sites of Europe that it is apparent they are of similar origin. As far as the writer is aware this appears to be the first mammoth bone found in this country showing evidence of human implements or weapons having left their marks on the green bone. After making a study of the bones and the marks and cuts they bear, Dr. E. B. Renaud, anthropologist of the University of Denver, and the writer are of the opinion that these mammoth bones were used as chipping and flaking tools by the people who were contemporary with them.

Several windblown holes in the same region were visited and mammoth bones were found in place in seven of them. At one spot a good portion of a scattered skeleton of very large size was found in the strata, so placed as to preclude the possibility that it had been intrusively or "secondarily" washed into the grey bed along with human artifacts at some later date. Mammoth bones and fossil bison bones from the grey bed are in the same state of fossilization in several of these blow-outs within an area of a few square miles and show the same type of cutting and tooling marks.

NOW we come to an important point. In nearly all of these sites, very well made Folsom type points are found; also numbers of other equally well worked points. The latter either are modifications of the typical Folsom points, or are made with the same skill and technique, and of the same materials, but in a few other distinctive forms. In many of these a series of very fine chips had been taken off parallel to one another, running from one edge completely over to the other, and often diagonally. These forms lack the usual longitudinal chipped-out groove, or have it only in modified patterns. The Andersons have found well over 100 of such flint points at these sites, and some of them are as deeply patinated as many of the Old Stone Age implements of Europe.

Besides the mammoth, two species of bison have been found. One of these appears to be identical with the *Bison taylori*, found with the original Folsom artifacts in New Mexico, and the second is a smaller species, nearly the size of the modern bison. This evidence appears to tie up the two areas as being nearly contemporaneous, and helps to date the original Folsom discovery.

Technical studies on the fresh water molluscs made by Dr. Junius Henderson of Colorado University at Boulder, Colorado, serve also to indicate Pleistocene or immediately post-Pleistocene antiquity for the beds in which the fossils and artifacts occur.

THE LIFE AND DEATH RATE OF CARS

By R. W. RIIS

MORE than 1600 makes of motor cars have been offered to the public in a little more than 30 years. Fewer than 50 of these have survived. Mortality among them has been great.

Why this surprising death rate? Why this great parade of models and makes and companies to the junk heap? What has been the cause? These questions were put to a motor-car manufacturer who has survived, carried on through good years and lean ones, who has never given up; and this was his reply:

"Some of them no doubt passed out of existence because of poor merchandising methods—but probably not many. The majority of these dead cars have gone to the motor-car graveyard because of a poorly designed product. Every automobile manufacturer can tell stories of millions of dollars lost due to some error of design which, with proper tests, would never have occurred."

What can a manufacturer do to guard against this? How can he keep out of the red ink? What wizardry must be accomplished if a company is to be one of the few survivors rather than one of the many who have died?

There is a very famous law called the law of trial and error. If any product, especially a mechanical product, makes good, stands the gaff, comes through—then with proper business management and wise selling and distribution it has a chance to succeed. On the other hand, if it fails . . . . .

No industry in all the world has proved this more strikingly or graphically than the automobile industry. Simple errors resulting in mechanical weakness have cost millions in a single year. Theories that have looked good on paper but wouldn't work out on the roads have wiped out cars and companies, brought bankruptcy and ruin.

In the beginning all companies built their cars on theory, coupled with the best available known practice. The car was run up a hill or two and down again, and if it worked it went out to the user. The user was the tester. If the car failed, he told his friends and neighbors. If enough cars failed, the maker went defunct.

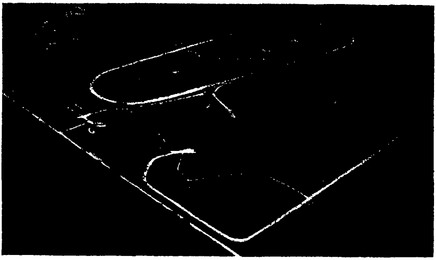
Finally it became evident that there must be a quicker, better way. It dawned in the mind of the manufacturer that he must develop a serum, so to speak, a vaccine. And so, slowly at first, grew up the testing field.

Such a field is the Studebaker proving ground at South Bend, Indiana. It covers 800 acres and represents an investment of 1,000,000 dollars. It has been operating over a period of years, developing a rugged product, has proved its worth, and has paid dividends.

Visit this testing ground and you are likely to find fierce action. It may be your good fortune to witness a "wall test." If you do, this will be the picture:

Their noses against a strong masonry wall, a row of cars stand lined up. You will find many makes of cars, competing lines, selling in the same price class. With clutch out, each engine is started. The operator shoves the accelerator to the floor-board. The engine roars.

Suddenly he lets the clutch in—with a bang. The car surges against the wall. The engine screams, whines, and dies.



Left: **Studebaker's million-dollar proving ground as seen from the air**

Lower left: **The "bath-tub test" to discover any ignition system faults**

Below: **A turn in such ground tests the stamina of the car and its parts**

The operation is repeated again and again. It is a heart-breaking, inhuman test. Nothing could survive it very long.

Fourteen times one car stands the test. Then a grinding and crashing of metal. The clutch gives way. The experiment is repeated with the next car. Twenty-three times and the transmission smashes. Another goes farther. Forty-seven times it has been sent into that wall, wrenching, lurching, groaning, and then!—With a crash, bits of broken steel and iron and a flood of fire and hot oil literally strew the concrete under the car. This ruin is complete. Down the line the engineers go. Some cars collapse quickly. Others battle stubbornly.

Finally a car "takes it" a hundred times. Tires on the drive wheels are sizzling hot, burned and blistered, worn to the cord. But the car stands up and is ready for more.

Trained engineers then gather up the [illegible], label them, take the cars to the laboratory—those that have fought bravely and those that failed. They tear them down, examine them minutely with microscopes and micrometer, measure and weigh the parts—and so they learn. They learn lots of things for the good of the balance sheet; they find the weakness and strength of their cars, and all competing cars, that they may not sell failures in Poison Spider, Wyoming, in Rio de Janeiro, or in Calcutta.

"We took six carbureters, of as many makes, under advisement and test," says one of the engineers. "We have built, on this testing ground, roads of concrete, macadam, gravel, and dirt. We drove cars with these carbureters 40,000 miles over all these roads.

"A new type of shackle was needed. We tried a number of types. Two of these types stood up under murderous tests on our testing field for more than 50,000 miles, and then broke down. The ball-bearing spring shackle we adopted stood up for 177,000 miles without failure."

Cars have been driven 1,750,000 miles in a single year in proving grounds. Deep ruts cut diagonally across roads, and a body of water gives the bath-tub test which is primarily to prove ignition parts. Cars are driven into this pool of muddy water at high speed. Besides proving the ignition system, it puts the chassis-lubrication system and the brakes to severe test.

So severe are some of the jolt tests that drivers, with grim humor, have complained of having to pick up loose ribs, digits, and vertebrae off the floor boards and take them home in a bundle for sorting at night. It isn't all fun and companies continuously change test drivers. The cars usually outlast the men.

Then there are other tests less trying on man-power. There are fatigue tests for metal, for example, which may be carried on in inside laboratories where another 1,000,000 dollars is invested. Here springs are bumped and metals pounded and thumped and bent mechanically.

"For example," testifies the laboratory expert, "a fan belt will ordinarily run 3000 revolutions per minute in service. We speed it up to 4000 and get the answer quicker. All the destroying forces of nature are simulated and intensified by our 'weatherometer.' It produces the effect of heat, intense sunlight, and rain. We use it in testing the weathering qualities of lacquers, top materials, and so forth.

"Then there is another thing, called a 'Stroborama,' a rather magical device which has the faculty of 'stopping' swiftly moving parts. It was invented in Belgium and uses a Neon tube. It acts like a slow-motion picture enabling us to watch high-speed machinery as if it were standing still.

The mechanism which determines the turning radius of a car as it is tested

One of the many testing devices: the accelerometer mounted on a seat cushion records on a moving tape the riding qualities of a car on all sorts of roads

"About four years ago, we launched an aggressive program in our engineering department. We decided to build outstanding type of performance in our cars. To do it we went directly to the laboratory and the proving ground. We ran laboratory tests at 40 degrees below zero and 120 degrees above. And when we were done there, we sent cars into the mountains, into deserts, and tried them out in speed contests on tracks at Culver City, California, and Atlantic City, New Jersey.

"REPRESENTATIVES of the American Automobile Association came to the plant, picked stock cars out of the assembly line, took them away, inspected them to make sure that they were in no way specially prepared or 'pepped up' mechanically. Then these stock cars were driven 10,000, 20,000, and 30,000 miles, at speeds averaging faster than a mile a minute, to new world's records."

It is difficult to trace the good a proving ground does. It is like a systematic audit every few months because it prevents trouble. It is like an insurance policy in that it protects the stockholders' dividends. It stands on guard against the bugaboo of red ink. And what is perhaps most important of all is:

There's another man's balance sheet that a well-equipped, wisely used proving field protects. That is the balance sheet of the buyer, the user of the car. To the user, the manufacturer's proving ground means lower upkeep and longer and better performance.

Queer looking locomotives bring the cane to the island factory where the cane is crushed and raw sugar is made

Inside the plantation factory. The crushed sugar cane is carried from one level to another on a conveyor at right

All photographs courtesy American Sugar Refining Company

FROM SUGAR CANE TO CRYSTAL CUBE

By ALBERT A. HOPKINS

HARDLY any substance we use has a more interesting life-history than a so-called "lump" of sugar—the word "cube" is perhaps more dignified and descriptive. When you drop the cubes into your coffee the life-history is ended. Sugar is the child of science and care, born in the hot maze of the plantation factory and given an education and a character at the refinery where it is pushed and pulled from building to building and from floor to floor during the cycle of manufacture. Before we start in Cuba and end at the towering buildings on our own waterfront, let us glance at some of the economic phases of the sugar industry.

Cutting cane between December and May. It is then brought to the *centrale* or factory

You will probably be surprised to know that at present we have in the United States an excess of refining capacity of one half over actual requirements or say 2,500,000 tons annually. What is the matter with sugar? Nothing except the war's aftermath and perhaps too much sugar legislation. From 1915 to 1928 there were 94 sugar bills introduced in Congress!

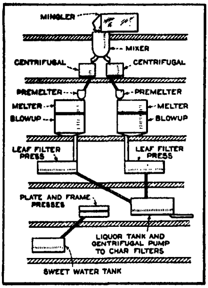
In 1929 the American Sugar Refining Company refined 1,257,842 tons of raw sugar at a profit of $8,166,361.47 or about a quarter of a cent a pound. What is needed is increased consumption and a halt in the growth of production. This will result in a slow recovery of the industry.

At the outbreak of the World War in 1914 about one third of the normal sugar supply of the world became locked within the battle lines of Europe. England could no longer secure her needs from Germany and Austria and turned to Cuba and Java for replacement. All the allied countries, and the United States later, restricted the consumption of sugar during the war. After its end in 1918, these restrictions were removed and consumers in all countries made a wild dash for sugar. In the United States in 1920, prices went to over 25 cents a pound. Such price levels attracted hidden stocks from all parts of the world and prices collapsed faster than they advanced.

Porto Rican, Hawaiian, and Philippine sugars enter the continental United States free of duty, and together with Louisiana cane sugar and western states beet sugars, now supply over half the yearly needs of the United States. Cuba produces far more than the remaining half. These normally supply all of our requirements. Cuba has found great difficulty in finding a market elsewhere for the surplus sugar that she cannot sell to the United States.

In describing the production and refining of cane sugar let us take Cuba as a source of supply. The cane is cut from January first to May first, and is transported on standard railways from

Storing the raw sugar in bags at the warehouse. The many storage bins are of enormous capacity the cane fields to the *centrale* or plantation mill where it is crushed under many tons of pressure to extract the juice. The cane refuse, *bagasse*, is used as fuel. The thin liquid or juice is treated with lime to neutralize the acids present, and, after being heated and clarified, is thickened in an evaporator and then boiled in a vacuum pan until the sugar crystallizes. Finally, the mother liquor is driven off in a revolving centrifugal machine and the moist raw sugar is bagged and shipped to the refinery in the United States.



Above: Raw sugar is mixed with syrup which is removed by a centrifugal. The washed sugar is then melted and the impurities are removed. *Left:* Diagram showing "wash house" processes which are carried on in various stories

Sugar refining, like other major industries, is availing itself of the advances in present-day science. Methods of production have greatly improved. Step by step the laborious methods of the past have been replaced by mechanical processes which have eliminated waste and reduced costs. Even with the greatly increased expense of labor, fuel, and materials following the war, the present cost of production compares favorably with 1914.

The important steps in the process of cane sugar refining are as follows: Landing, storing, and dumping the raw sugar; washing the

the raw sugar; clarifying the raw sugar solution by filtration through cloth; purifying and decolorizing the raw sugar solution by filtration through boneblack; boiling the char-filtered liquor to produce refined granulated sugar; spinning and washing the refined granulated sugar; drying and screening the refined sugar; packing, warehousing, and shipping the refined sugar.

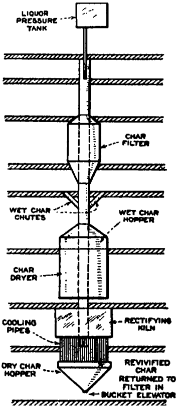
The refinery "seamstress" is sewing cloth on the leaf of a filter press

At the central station for clarified sugar liquors the color and strength are tested. The liquor has been passed through the granular boneblack in the char filters

The first steps in the operation of a

ing and storing the bags of raw sugar. The bin capacity enormous, a refinery using from two to five million pounds of raw sugar per day.

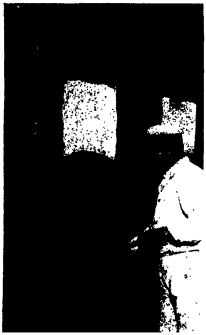
The first refining step is washing the raw sugar to remove the partially dried syrup adhering to the crystals, the process being carried out in what is usually termed the "wash house." Raw sugar from the storage bins is transferred to the top of the wash house by conveyors and elevators. Here a "scroll," or "ming-



The char filters extend through several stories of the "filter house"

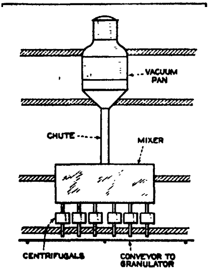
***Above:* The vacuum pans boil the sugar liquor to crystallization under vacuum. *Right:* "Pan house" showing the relation to the centrifugals**

ler," thoroughly mixes the sugar with small quantity of syrup obtained from previous washing to form a pasty mass termed "magma," which is run into large tank of special form, called "mixer." This tank is equipped with slowly revolving stirrer to keep the sugar crystals in suspension. From the bottom of the mixer the magma is fed to the centrifugal machines through large slice valves.



The "sugar boiler" is taking a test sample without loosing the vacuum

The modern raw sugar centrifugal machine is cylindrical in shape, either 40 or 48 inches in diameter, direct electric drive, self-discharging, and has a perforated vertical side wall. The bottom of the cylindrical basket ends in a funnel, above which is a large disk fastened to the center shaft and revolving with the machine. The centrifugal is charged while running at slow speed, the magma from the slice valve falling onto the disk and being thrown off against the wall of the basket to build up a uniform layer, about six inches in thickness, against the vertical wall. After charging is complete, the machine is run at the full speed of about 1000 revolutions per minute.

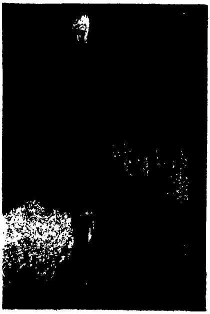


When the syrup, which was mixed with the sugar and which acted simply as a carrier, has been spun off through the perforations of the side wall, the sugar is washed with water by means of a special spraying device. Finally the brake is applied and the machine is slowed down to the point where the sugar wall breaks, the loose sugar falling out through the funnel at the bottom and into the scroll which conveys it to the melter. The complete cycle of operations takes about 3½ minutes, and the centrifugal machine discharges from 550 to 750 pounds of washed sugar. The washed sugar, although of 99 percent purity, must go through many refining operations in order to remove this one percent of impurities, and produce the high grade product demanded. After mixing with water to form a solution containing about 64 percent solids, it is ready to continue on through the process.

The next step is the removal of the suspended impurities. The raw liquor is heated in what are called the "blowups" to about 180 degrees Fahrenheit, made neutral or slightly alkaline by the addition of milk of lime, and to it is added an inert filtering medium, known as diatomaceous earth. The liquor is agitated to keep the filtering medium in suspension and is then passed through leaf filters at a pressure as high as 60 pounds per square inch. A cake, composed of a mixture of diatomaceous earth and the suspended matter, such as fiber, gums, and so on from the raw sugar, is built up on the surface of the leaf while the clear filtrate passes through and out of the press.

THE next step in the process is the removal of the soluble impurities, largely organic coloring and mineral matters by passing the clarified liquor through granular boneblack. This material is held in large cylinders, of about 1200 cubic feet capacity, called "char filters." The liquor after being filtered through the boneblack is clear, sparkling and colorless, and is now ready to go to the vacuum pans where crystallization occurs. The char is washed, heated in kilns, and used over and over again.

The vacuum pans are large copper or cast-iron containers, from 12 to 16 feet in diameter, heated by copper steam coils, which boil the liquor under vacuum at a temperature ranging from 120 to 180 degrees Fahrenheit, depend-

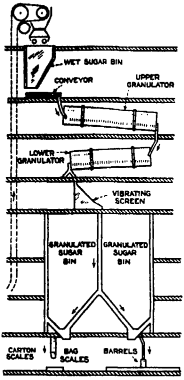


Vacuum pan discharging the sugar into the mixer above centrifugals

ing upon the kind of sugar desired. By this boiling the crystals are formed and the progress of the operation is determined by withdrawing from time to time a small quantity of the contents of the pan without breaking the vacuum, by means of a "proof-stick" or plunger which deposits the sample on a small glass plate to be viewed by transmitted light. When inspection of sample shows crystals to be of the desired size, the steam is turned off, the vacuum broken, and the pan emptied, the contents running into mixers similar to those used in the wash house.

FROM the mixers the warm mass goes to the refined sugar centrifugals which are direct driven, but not self-discharging. After spinning and washing off the mother liquor, the remaining crystals are discharged by means of a mechanical unloader, which is a flat plow fixed to a vertical shaft. While the centrifugal is rotating slowly the plow deflects the sugar from the side wall through an outlet at the bottom. From the centrifugal machines, conveyors carry the moist crystals to the drying apparatus.

Drying is the final step in the refining process, the drying apparatus, called "granulators," being horizontal revolving drums, about 30 feet long and six feet in diameter, set at a slight pitch so that the material introduced at one end will travel slowly to the other. "Baffle plates" or shelves on the inside pick up the sugar and allow it to fall in a shower, a current of heated air being drawn through the drum to carry off the moisture.



Above: Packing the refined sugar in cartons by automatic machinery, preserving purity. The drawing shows the "finishing house" where sugar is dried and packed

The refined sugar is removed from the centrifugal by means of a plow

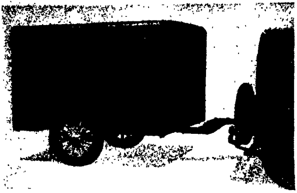
The dried product is then screened and finally conveyed to bins from which it is packed for the market either in bulk bags and barrels, or in small packages for home consumption.

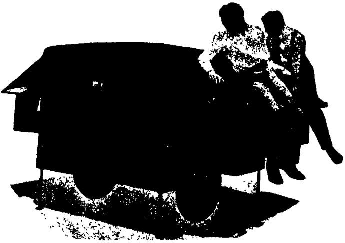
Cube sugars or pressed tablets are made by molding the moist granulated sugar into the desired shape by a special machine. The moist cubes are dried for several hours on plates in steam-heated ovens, after which they are ready for packing. The highest grade tablet sugar is made by a special and costly process. Liquor of the highest possible purity is boiled to grain at high temperature, the mass is run into molds which, when cool, are spun in centrifugals, the sugar being washed by a saturated, high grade, sugar liquor. The sugar is taken from the molds in the form of rectangular plates, ⅝ of an inch thick, which are dried in ovens. These plates are sawed into strips which are clipped by knives to form the brilliant, glittering tablets with the characteristic uneven surfaces. The superior quality and appearance of this sugar justifies the added cost of manufacture.

We are indebted to the American Sugar Refining Company for our photographs and for information relative to the technical processes of refining.

Running tablet sugar liquor into molds to produce rectangular plates which are dried, sawed, chipped, and packed

Circular saws cut up the plates of crystallized sugar into strips which are in turn chipped to size by keen knives





Above: Globe-Trotter ready for the road. ***Right:*** Same trailer ready for the night, with sides extended and ground supports in place. Men sitting on side show the great strength of this construction

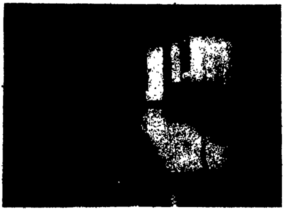
Photographs above courtesy The Globe-Trotter

The interior of the above trailer with the two double berths occupied. A curtain may be hung down the center

One of the double beds, folded, serves to seat four comfortably, while a meal is cooked and served opposite

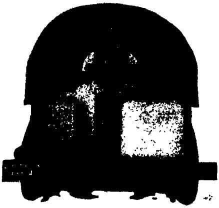
Photographs below courtesy Split Coach Corp.

Left: A sport roadster with a Split Coach trailer. ***Above:*** A trailer of the same type with sides extended and roof raised to afford ample room. When the body is to be extended or the car uncoupled, tripods support the trailer



Left: Interior of the above trailer. When made up for the night, there are upper

Right: Another type of Split Coach trailer with a "caravan" top. This model, lower in price than others by the same company, may be as fully equipped with personal comforts as is desired



VACATIONING AWHEEL

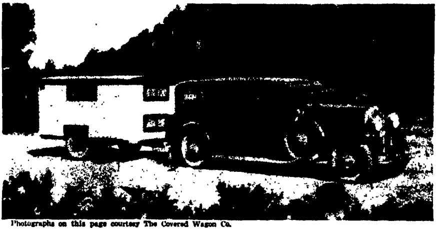
By A. P. PECK

THE coming of the motor car released the city- or town-bound adventurous spirit and enabled him to reach out-of-the-way places heretofore closed to him by the bars of distance. But even then he was bound by certain limitations imposed by the question of food and sleeping quarters unless he was hardy enough to withstand the rigors of a more or less primitive camp. Recently, however, there have appeared on the market, in increasing numbers, camping trailers that can be drawn by any motor car, small or large, and that provide in one unit all the comforts of home.

These trailers have been so designed and constructed that they follow the towing car faithfully and impose but little load on the car chassis. It is said that a properly designed trailer will decrease the top speed of the average car only four miles per hour. In backing and parking, the trailers are not found to present any great difficulty; it is only necessary to allow for the greater effective length of the car, and to remember not to make too sharp a turn. In fact the trailer illustrated at the bottom of the opposite page is equipped with two safety chains that prevent the trailer from assuming too sharp an angle with respect to the car.

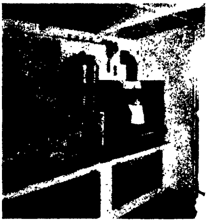
From the trailers available we have selected three representative types. The one illustrated on this page has a solid body in which only the floor in the rear section, the kitchen, drops to afford ample head-room while working there. In the one shown at the top of the opposite page, the sides expand as shown to permit the making-up of double berths on each side. In the one at the bottom of page, the sides expand and the op rises. Thus more than enough room is had in all dimensions. On all models simple yet positive coupling devices connect trailer and car.

All of these trailers are equipped with lectric lights, storage space for clothes, oilets, and facilities for cooking and washing.



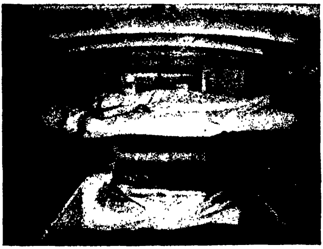
Photographs on this page courtesy The Covered Wagon Co.

A Covered Wagon trailer in the heart of vacation land



The kitchen with built-in gasoline stove. Note water cooler on shelf

Opposite the kitchen is the pantry with 25-pound capacity ice-box

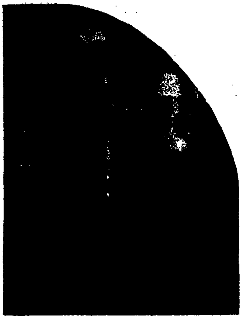


Two double berths in sleeping car fashion can be quickly and easily made up. Storage space is under the side seats

Whiling away an evening or a rainy day is easy in this trailer. There is ample room to play cards or just lounge

THE BROOM IN INDUSTRY

By EDWIN P. NORWOOD



The broom plays an important part in the Ford plant all day long in every section

FOR some vague reason, never satisfactorily explained, there existed for years the belief that a factory could not operate without creating an endless amount of dirt. Moreover, falacious as this premise was, matters did not stop there. On the contrary, bad logic and unthinking management not only accepted the dirt, but to all outward appearances, actually harbored it. The three S's—smoke, soot, and smudge—were as constant as they were typical. Cobwebs consorted in every nook and corner. Litter was everywhere.

This condition fostered innumerable handicaps. To name but a few, the cluttered floors not only hampered the movements of men at their work but often caused mishaps. Space that might have been utilized for better purposes was tied up by piles of odds and ends seldom drawn upon and of scant value. Because of too few and rarely washed windows, shop interiors preserved a twilight gloom even on days when the sun shone brightest. Considering industry as a whole, there was incalculable waste—a waste of material, a waste of time, a waste of efficiency, a waste of light, and a waste of men. Furthermore, there was an inequality of product. Consistency of workmanship was not apt to be found in so haphazard a setting.

BUT, happily, the factory world moves. If there is truth in the old saying that one may judge a farmer's products merely by having a look at his fences, then one may now, and with equal assurance, estimate the quality of a factory's output by observing its windows.

For it has been amply demonstrated by those who have had the wisdom to make the try, that a clean shop produces better articles, more articles, and these at a much lower cost than one that is dirty, badly lighted, and littered with leavings. The rule works both ways. That is, the more attention given to orderliness and cleanliness, the greater the return. The less attention, the less return. Indeed, the expense of this phase of upkeep is insignificant when compared with the results directly traceable to it.

There is no one now engaged in the business of manufacturing who is more positive on this point than Henry Ford. He has the right to his convictions because he has proved the correctness of them. Several years ago he made this assertion:

"No shop can have morale without cleanliness. We tolerate makeshift cleanliness no more than makeshift methods."

At the time that statement was made something less than a thousand men were engaged in making this cleanliness apparent. Now more than 4900 are employed in what is called the "clean up department" at the Ford Motor Company's Rouge Plant, in Dearborn, Michigan. This force is engaged solely and continuously in the work of preserving buildings and accessories in a condition of cleanliness. It would appear that keeping things clean shows returns.

For the sake of designation, these men, according to the nature of their work, are called sweepers, window washers, painters, pick-up men, and so forth. None receives less than the Ford minimum wage of seven dollars for an eight-hour day, and they are given steady employment. Does that seem fairly high pay for, say, a man who does nothing but handle a broom? Assuming for a moment that it does, this is to be remembered: Though called by the names just listed, these men, as viewed from the Ford idea, are far more than mere cleaners. They are those who, by their constant attention to the job given them, increase the efficiency of those other men who work at machines. The work of the two is, to use a shop term, cast integral. They are of a piece. Otherwise we have a return to the old factory of uncertain output.

ASK any Ford shop foreman why his department benefits from cleanliness and he will not fumble the answer. In all probability he will enumerate some points that are entirely new to you. To begin with there is the importance of sunlight. Frequently washed windows admit the maximum. Good light serves many ends. It raises the visibility of all things in the shop, cuts down eye strain, reduces the chance of work being spoiled through insufficient lighting, and, to a large extent, prevents accidents. Also, it costs nothing to produce, excepting, of course, the means of giving it freedom of entrance. The

The plant's highways are never as littered as this; cinders were scattered here to show most effectively the operation of the special combination sprinkler-sweepers shop that takes advantage of all the natural light that is available keeps down its electric light charges. Furthermore, sunlight shows up dirt.

"It's the best inspector on the whole staff," one of the foremen declared. "Anybody knows that if there's one thing that a dirty wall or a dingy pocket can't stand, it's a straight shot of sunshine. What may pass as pretty fair in a dim light often looks mighty bad when you flood it with light through good clean windows."

There are plenty of windows in the Rouge Plant buildings to effect this flooding. If joined together they would total an area covering something like 330 acres. A great many of these transparent acres are washed as often as once a week. To give greater efficiency of penetration and to avoid splashing, the interior panes are cleaned with whitening. That was once the method employed on the outside. But the work was slow and took too many men from jobs equally important. So one day a long handled brush was rigged out and a small hose run to it up the side of the handle. The thing worked splendidly. Now a hollow handle of light weight metal has displaced the hose. A hose is still used but this is screwed on at the bottom. The window cleaners connect their implements to convenient taps and work.

As sunlight in huge quantities is thus admitted, it is turned to proper account when it reaches the inside of the shops. Much thought has been given to that extremely important detail. To send the light downward, where it is most needed, the upper part of the walls, girders, and that portion of the ceiling not taken up by skylights, are painted in egg-shell white. Experiments demonstrated that this slightly glossy finish made an excellent reflector.

Other experiments decided that a dark blue, tinged with gray, was easiest upon the eyes of workers. Therefore all machine frames, housings, safety covers, and sheathings are painted what is termed "machine blue." For similar reasons, the walls to a point a little above what is ordinarily thought of as wainscoting height, are finished in a rather deep gray. Everywhere there is consistency in the colors used. Stock-bins, racks, and timekeepers' desks are always olive green. Railings are usually black. Stacks, and furnace and oven exteriors are coated with aluminum paint which resists discoloration from heat. But all fire appurtenances, such as alarm boxes and hydrants, are in red. This color likewise designates the location of first aid stations. Things needed quickly can be seen quickly.

Painting, like window washing, goes on continuously. The exterior parts of machinery are painted perhaps most frequently. This is not done by the cleaning squad men but by those within the respective departments. Every foreman is responsible not only for the condition but for the appearance of the machinery under his supervision. At any hour of the day he is privileged to send to a supply crib for paint. And he is instructed to make use of it whenever the slightest opportunity affords. In consequence the amount of "machine blue" applied at the Rouge Plant each month will exceed 5000 gallons. That is enough paint to give a single coat to a fifth that many medium-sized cottages. And while on the subject of quantities, almost 11,000 gallons of egg-shell white are used on interior walls and ceilings every month. That which this paint covers reflects a large amount of sunlight and so makes working conditions easier, work more efficient, the output greater, and the costs lower. Making every day paint-up day is sound economy.

One man may paint switch boxes; another, motors; still another, machine frames—paint is always being used somewhere in the plant

Windows are kept clean. The brushes have hollow handles to convey the water

Cement floors and concrete exteriors of buildings are treated with a paint specially prepared for this type of surface. Acid-resisting coats are used on all battery room floors, and fume-proof enamel is applied to the walls and ceilings. This type of paint extends to use in the laboratories.

So the washers of acres of windows let in the sunlight and the painters see that all which this sunlight examines is good to look upon. Between the coming and going of the painters the washing squad keeps the walls fre dirt and splatterings. Howe there is little dirt. The scrubbers, and the sweepers that precede them, are too active to allow of it to gather. First the floo treated with a cleaning soda, then flushed with hot water, next scrubbed, then rinsed, and lastly, squeegeed. Two hundred mops and brooms are worn out in the Motors Building alone, every five days—from which it will be gathered that much "elbow-gre used in cleaning.

That the floors may be kept in a condition free for mopping, two other sets of men have particular jobs to perform. The pick-up crew keeps all floors clear of scrap material too large to be easily handled with brooms. They go about with small, light carts. That which they gather travels to the Rouge Plant salvaging department to be turned to various uses. Smaller bits—metal leavings, stray chips, or steel shavings that have eluded the conveyors provided to receive them—are placed in rubbish cans, of which there are thousands throughout the plant. This work goes on hour after hour so that at no time are men who are engaged at machines, at furnaces, or in any other line of work ever obliged to walk across or stand upon anything but an absolutely clean floor. Yet the sweepers never interfere with operations. It is interesting to watch how they contrive to introduce themselves and their brooms without, apparently, interposing either.

It is hard to believe that in this spotless area 10 open hearth furnaces are operating continuously

Much more goes into the rubbish cans just mentioned. At the end of meal periods, boxes or bags that have contained lunches, newspapers that are to be thrown away, all things that would otherwise litter the shops, are deposited in these receptacles by the entire factory force. No one need take more than a half dozen steps to find such a container. Making use of them keeps the surroundings a more pleasant place in which to work. The rubbish cans are emptied every two hours. In reclamation yards situated outside the various buildings, the contents are immediately sorted and all things, including the smallest pieces of metal, wood, and clean paper, sent to the division of salvage. The comparatively little that remains following this process is scooped into dump tractors and used for filling uneven ground at various points in the plant property.

TO facilitate the work of the scrubbers, every shop has its system of pipes and faucets. Boiling water seething with steam comes through mains that are laid in tunnels which lead from the power houses. From these larger conduits, a net-work of smaller pipes travels to points convenient for use. They sprout from almost every supporting post.

Between many of these columns are hundreds of large pipes of quite a different character that disappear through the roofs. These are part of the air suction systems. Leading upward to them are smaller pipes with nozzles set close to work done by such machines as the grinders. As quickly as emery, fiber, or the dust of metal drops from the wheels that produce it, that dust is drawn into these nozzles to be shot into collector bins stationed on the various roofs, there to be placed in bags and disposed of according to kind. And while this operation is apart from a story which deals with the cleaning squad, it nevertheless has much to do with the cleanliness of the surroundings in which men work. It furnishes scores upon scores of invisible brooms that not only keep air and lungs clean, but greatly reduce the task delegated to those of cornstraw and fiber.

All floors in every department and in every factory office at the Rouge Plant are scrubbed every eight hours, and many areas immediately adjacent to machines, every two hours. The wider aisles and interior driveways, less subject to oil or litterings from machines or furnaces, are mopped once a day. That represents quite a job. There are almost 7,000,000 square feet of floor space in this huge galaxy of buildings. True, a portion of it is occupied by machinery. Yet perhaps a half is accessible to mop and broom. Moreover, that which is accessible is nothing less than that. There are no unreachable holes or unsavory pockets.

Whatever the exact free floor area may be, these figures are positive: Each month the cleaning department uses more than 1700 barrels of general cleaner, almost 800 barrels of soda ash, 70 barrels of soap powder, and calls upon the salvaging department to supply it with mop pails at the rate of 150 a day.

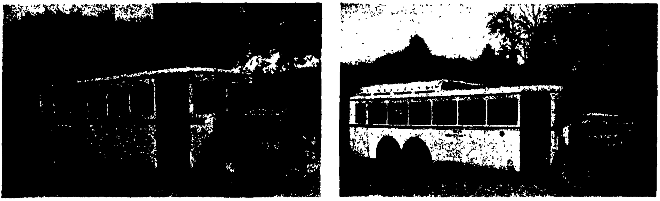
No matter where you go, whether to the carpenter shop hidden away at one edge of the 1100 acres that form the plant property; to the locomotive repair shop situated in an equally remote corner; or to the general assembly building which stands in the heart of it—everywhere are to be found men keeping things clean. And in all places you will see an abundance of sunlight. Consider the motors building. It is almost a third of a mile long by half that in width. Down its length runs a covered street, easily wide enough to allow two trucks to pass. Walk along it, stop when and where you will and look in as many directions as you like. Always, about you and as far as the eye can reach beyond, you will see things bathed in sunlight.

OR go to the open hearth building where furnaces are making steel and this steel is being cast into ingots. Adjacent to it is the steel mill where the ingots are being converted into blooms and the blooms turned into billets and bars. Sunlight. Tons of it!

Can a steel mill and an open hearth furnace building be kept clean? There was a time when such an idea would have been laughed out of industry. Yet here the visitor may spend an entire day and depart with his linen less soiled than it would be in an equal number of hours spent in a metropolitan business district. Such, at any rate, has been this writer's experience, not once but upon a dozen occasions.

Considering the whole subject, a pure fundamental asserts itself: Excellence of material and workmanship to one side; measurements that limit some motor parts in the making to ten-thousandths of an inch, ignored for the moment; rigidity of inspection in manufacture likewise dismissed; how, you ask yourself, could anything save that which is fine come from shops kept so scrupulously clean? And you depart carrying a pretty fair notion as to why Henry Ford finds it good business to employ almost a twentieth of the Rouge Plant force of more than 100,000 men, solely to give battle to litter and dirt.

White uniformed "stokers" work in this "ball room" which is, in reality, a furnace and boiler room. The popular idea is that this is a place of ashes and coal



Two examples of Diesel-powered buses that are made in regular standard models

THE DIESEL ON THE HIGHWAY

THE present-day gasoline engine for commercial vehicles has reached a stage of development at which revolutionary alterations in design with a view to increased working economy appear [illegible] gives a stimulus to the idea of obtaining a further decrease in running costs of commercial vehicles by the use of a much cheaper fuel; and already for many years the foremost engine designers of the world have been occupied with the problem of applying the principle of the Diesel engine to a power unit for motor trucks, buses, and so on.

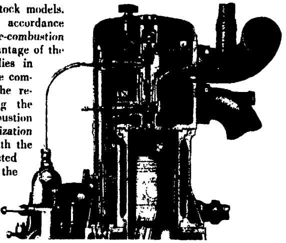
In this attempt to develop the Diesel for highway use the designers were confronted with several serious problems. The most important of these was the excessive weight of the Diesel and the necessity of getting a speed with it comparable to that of the ordinary gasoline engine. These two problems were inseparably connected, since it is well known that high-speed machines can be constructed much lighter in all their parts than slow running machines for equal power output. In addition to this, there was the necessity, in connection with the high speed, to inject very small quantities of fuel in a finely atomized state and with sufficient speed into the combustion chamber, and to adjust this to the extremely variable load of the commercial vehicle.

Some months ago there was introduced to this country a motor bus powered by a Mercedes-Benz crude-oil, or Diesel, engine. Representing the result of years of thorough research, this [illegible] commercial vehicles in Europe; and even though its introduction to this country is of comparatively recent date, American companies are already operating a large number of buses with this power unit. To our knowledge this is the first and only complete Diesel-powered motor bus to be manufactured and sold in regular standard stock models.

The motor functions in accordance with the Mercedes-Benz pre-combustion system. The principal advantage of the pre-combustion chamber lies in the fact that it replaces the compressor, since it fulfills the requirements of introducing the fuel into the actual combustion chamber with perfect atomization and intimate admixture with the air. The fuel is not injected directly into the part of the cylinder swept by the piston but into a pre-combustion chamber where it undergoes partial combustion. The extra pressure thus generated in this small chamber drives the fuel-air mixture through a special inserted burner into the combustion chamber proper.

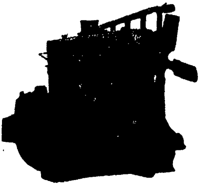
This new bus crude-oil engine has six cylinders of 105 millimeter bore by [illegible] roke. At 1300 r [illegible] tions per minute, the engine delivers 70 horsepower. The fuel pumps—one for each cylinder—are collected in one block housing.

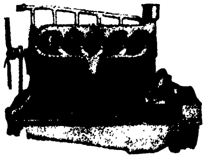
The atomizers, which are also called injection valves, are spring-loaded needles which close up the atomizer opening with a conical seating. The section of the needle projecting upon the seating gives the fuel an opportunity to elevate the needle against the pressure of the spring. The fuel is, of course, supplied from the pump in a measured quantity for each cylinder.



Section through a cylinder showing: A, the fuel spray; B, glow plug; and C, pre-combustion chamber

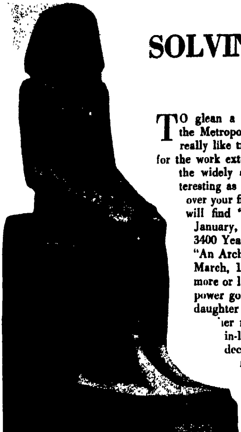
This Diesel is started with an electric starter, exactly the same as any gasoline engine. To facilitate the starting of the cold engine, Bosch incandescent heaters, commonly called "glow plugs," which project into the pre-combustion chamber, are heated by the current from the battery and are then dispensed with.





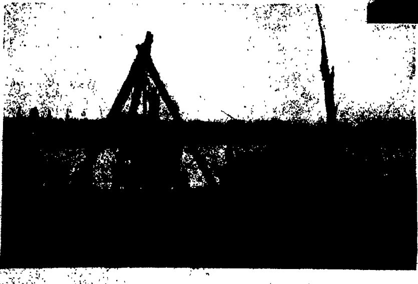
The new bus Diesel engine is a clean design. The fuel pump is shown on the side in the left-hand picture

SOLVING A 3400 YEAR OLD EGYPTIAN ENIGMA



TO glean a knowledge of the excavations of the Metropolitan Museum of Art at Thebes is really like trying to follow a three year serial, for the work extends over that period of time and the widely spaced chapters become more interesting as we progress. If you will look back over your file of the SCIENTIFIC AMERICAN you will find "Adventurous Archeology" in the January, 1929 issue; "Egyptian Vandalism 3400 Years Ago" in June, 1929, and finally "An Archeologist-Detective at Work" in the March, 1930 issue. All these articles refer more or less to Hat-shepsut whose desire for power got her into posthumous trouble. Her daughter married young Thutmose III, who her nephew and stepson! The mother-in-law kindly acted as regent but she declined to quit when he reached his majority. She was the antique prototype of Catherine of Russia and other female tyrants. For 12 years this indomitable mother-in-law, et cetera, kept the throne of Egypt. She was very vain and built the temple of Deir el Bahri to justify her assumption of the rule and depicted herself as a man. The irate son-in-law after her death extirpated all memorials to her and it is in the quarries and dumps that we must look for the fragments. This having been done and the world combed for missing pieces, we can at least have the satisfaction of seeing how this wilful woman really looked.

Mr. Herbert E. Winlock, who is one of the best writers on archeology we have, describes the later developments in his last report. It will be remembered that in previous years parts of a marble-like limestone head and other portions of the body had been found. The material suggested a headless seated statue of Hat-shepsut in Berlin. Surmise led to certainty when Mr. Winlock went to Berlin with photographs of the fragments. He says: "Once face to face with the statue then I felt perfectly certain that we were dealing with one and the same monument. In the division of finds with the Egyptian Antiquities Service at the end of our 1928-1929 season the head and other fragments fell to the share of the Metropolitan Museum." In our March, 1930 article we stated that negotiations were afoot for the reuniting of these statues. The negotiations were successful and the Director and Trustees of the Metropolitan Museum and the Prussian Minister of Education ratified the proposed exchanges which were made. As a result the Berlin mu-



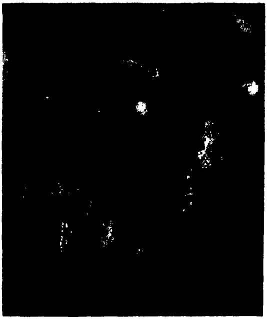
Upper left: The far-flung fragments of the statue of Hat-shepsut assembled and restored. *Left:* Loading statues on the truck at Deir el Bahri. *Right:* Ferrying the statues across the river Nile. *Lower left:* Unloading the truck (using an American hoist block) opposite Luxor Temple. All the fragments carefully boxed seum obtained a most imposing granite sphinx and the Metropolitan Museum acquired a complete seated statue which will always be one of the prizes of the Egyptian Department. The account of the attitude of the Berlin authorities is most refreshing and shows the real unselfishness of science.

Mr. Winlock refers most interestingly to such curious archeological finds. "Such accidents—and some of them far less excusable—have separated scores of mutilated works of art in the past, but for it to be admitted that such separations are final and forever hardly fits the modern way of looking at things. It smacks too much of the old-fashioned amateur—and just a bit of the collector of curios, to whom a meaningless scrap of rock becomes a treasure if it has been chipped off the corner of the Great Pyramid or fetched from the Great Wall of China. At least, to our intense mutual pleasure, Dr. Schäfer (of the State Museums, Berlin) and I found each other feeling that way."

The work of putting together the fragments was done in New York with extreme care. Mr. Winlock says: "After all, it was only guesswork whether the fragments would fit, but when even the last sliver from the tip of the nose clicked into place, something louder than the proverbial sigh of relief escaped me."

A spare wig found in a coffin is stiff with sticky antique pomade

The rest of the report is extremely interesting, detailing some of the routine work necessitated by the previous explorations. The methodically plundered tomb of Meryet-amun which we have previously described gave up many objects of interest. A large amphora or jar contained a yeasty sediment of beer which was analyzed by Dr. Grüss of Berlin who found that the yeast could be called "pure." About 3400 B.C., the yeast was a wild organism full of impurities, but "after 2000 years the Egyptian brewer had developed a culture" says Mr. Winlock, "almost comparable to the modern, without the aid of the paraphernalia of microscopes and filters."



All photos courtesy Metropolitan Museum of Art

In the vast, cavernous shops of the Metropolitan Museum the statues are being repaired

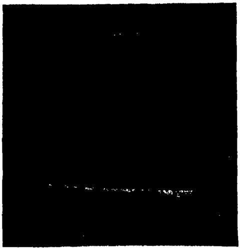
The shattered head of a sphinx of Hat-shepsut is a portrait statue

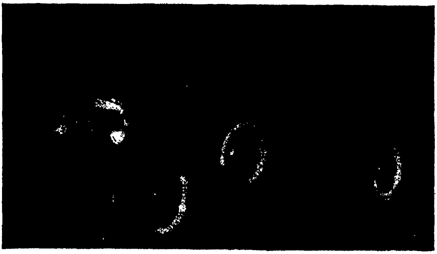
The Osiris figure 25 inches high concealed a roll of papyrus *(left)*

With the mummy of the King's daughter Entiu-ny the explorers found in the coffin a spare wig remarkably preserved but almost solidified with the still sticky pomade in which it had been soaked. An examination of the mummy showed that she was a very short woman, 4 feet 10 inches tall, but extraordinarily fat. She was about 70 years old, but the hairdressers and undertakers made her look weirdly and grotesquely young. The burial furniture even of one of Entiu-ny's rank was, in her day, never as elaborate as it had been in early, more primitive times.

Scandals had been very prevalent in ancient Thebes and the Thebans began to realize that their dead could hardly keep their treasures because of the dishonest actions of the living. Therefore they turned rather to questions of conduct for the departed to observe before the strange collection of gods, genii, and demons who formed such an important place in the uncanny universe to which they were bound. So it was not surprising to find a "Book of the Dead" as a *vade mecum*. In the one found with Entiu-ny it was an 18½-foot papyrus enclosed in an Osiris figure 25⅝ inches high. There was a circular patch of wood in the bottom held in place with plaster. When this was pried loose, the papyrus easily slipped out, almost as fresh as when it was enclosed. The papyrus is now on exhibition at the Museum.

THE ARISTOCRATS OF MOTORDOM



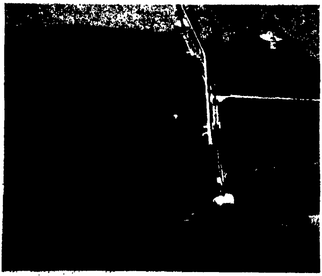


Right: **Marmon sixteen has been unified and there is no appearance of a body set on a chassis.** ***Above:*** **The built-in trunk encloses the gas tank**

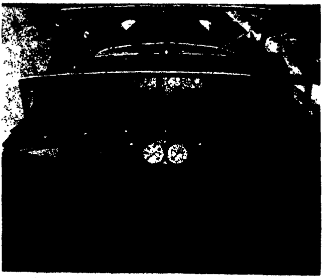
THE 26th annual Automobile Salon was held at the Hotel Commodore, New York City, recently and presented a notable collection of cars of the highest type ranging in price up to 25,000 dollars. The 90 models exhibited had an aggregate value of over 1,000,000 dollars. Most of the bodies shown were the handiwork of individual coach builders who specialize in designing cars to suit the individual tastes of particular customers. Certainly the showing indicates that the art of the coach builder has developed very radically along artistic lines. The product of "Brewster & Co., Inc." is a far cry f "Brewster of Broome Street" which synonymous with the highest grade of coach work a generation and a half ago. The modern coach builder knows no geographical bounds and some of the best bodies shown came from Pasadena, California. Practically all the chassis were of standard make. The cars represent a great variety of styles and the newest ideas are introduced. Garish colors were generally absent and the tendency was towards subdued colors in exterior finish. The interior finishing, on the other hand, showed much individual development. The selection of woods was very carefully made and the cabinet work was of a very high order. The bodies were generally lower than last year and the passenger accommodation was comfortable as to seats. There were many convertible models shown and it is evident that people who can afford such expensive cars want an all-weather body.

It is not true, as has been reported, that all the cars were arranged to match shades in milady's Paris gowns. While we may have hats, shoes, gloves, and bags to match the costume, we have not yet put the car into the color scheme although some fashion editors would like to make us think so. Some of the cars, more particularly of the sports type, are very rakish in appearance with "laid-back ear" effects.

The metal parts do not hide their light under a bushel and stainless steel and chromium plate are very much in evidence. Polished radiator screens were quite a feature of the show. On some of the models the metal tire cover harmonizes with the rest of the body. Longer wheel bases are made necessary by the longer hoods required by the great

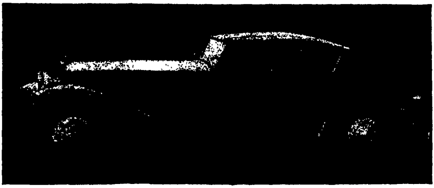


Chrysler Imperial 8 phaeton has an airplane cockpit effect in a long and swanky model. The body is by LeBaron



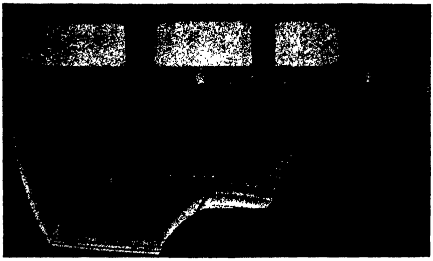
Cadillac sixteen-cylinder phaeton has a disappearing rear windshield. Clock and speedometer are both duplicated

power plants. The size of the doors is very noteworthy. In one Italian car one door, over five feet long, took the place of the usual two. On this car the running board was pontoon-shaped. In some of the new designs the body sides are carried down over the side of the frame, covering the running boards. Many of the cars displayed very large bumpers of the single-bar type; others are characterized by large head lamps of entirely new design streamlined to harmonize with the car and to cut down the wind resistance.



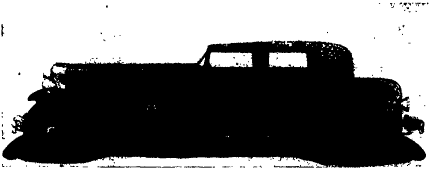
Rolls-Royce four-passenger sport car looked 21,750 dollars worth and made a sensation. The lines are ultra-modern with dashing curves and sloping windows

Some of the woods employed are so rare that it would take a professor from the Forest Products Laboratory to name them. Some of the inlays are in silver and one even had Wedgwood medallions.

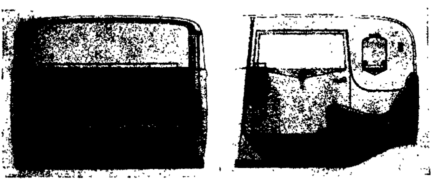


In this Duesenberg car, with body by Judkins, are some of the unhallowed delights of home, for "passengers only", in the cellarette. It is all there but the rail

Several of the cars had a duplicate instrument board, usually somewhat abbreviated. The opinion as to the merits and disadvantages of such an arrangement varies. Some contend that it conduces to "rear seat driving" which is dangerous, as we all concede, and others think that if you cannot trust your chauffeur with a high-priced car and your lives that another speedometer will not better matters.



One of the cars shown had a fine radio with concealed loud speaker. While of course we have had radios in cars for some time, they have rarely been so cleverly concealed. There was another car scheduled for the Salon which was kidnapped at St. Louis and never got to New York at all. We show the reason diagrammatically. Perhaps the new owner wanted to enjoy his new car immediately. Well, it had a bar, if the truth must come out and there was ice "and everything." The maker of the chassis exhibited another car which in addition to the radio had a cute little boudoir powdering alcove about six by nine inches which can be lighted independently.



The interior of this luxurious car, shown above, possesses many novel features. There is a radio with loud speaker, a duplicate speedometer, and a clock. At the side is a mirror and cabinet independently lighted for the use of the ladies

We will not attempt to catalogue the bewildering displays. We have selected a few of what we might call the high spots of the show and we present these in pictorial form, some of the photographs being specially taken for this purpose. There is one feature of the Salon which is especially noteworthy and that is the brilliancy of the patronage. The leaders in social life and in the business and professional world lend their endorsement to this super-show by their presence. Society reporters are on hand and the list of distinguished visitors sounded very much like a list of box holders in the golden circle at the opera.

The sales at the Salon were very large, 341,000 dollars worth being disposed of in the first two days, the volume of business being much greater than last year. One company alone received orders for 22 of its specially built cars.

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

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Teach Deaf and Dumb Children with Gas

DEAF and dumb youngsters are finding gas an ally in their struggle for an education, according to a report from London.

They watch the flickers of a gas flame as an instructor pronounces the letters of the alphabet, and then attempt to imitate the teacher, visualizing their effort by the vibrations of the flame. The average student learns the alphabet in three months by this method, educators report.

A piece of cable imbedded in concrete "grounds" the static of a car

Wire Cable Static Absorber

WHAT is perhaps an unusual use of steel cable recently came to light when a photograph was received by the Broderick and Bascom Rope Company from one of their Florida distributors.

The photograph, which is reproduced on this page, shows a small section of steel cable imbedded in the roadway just outside the toll station at one end of the bridge spanning Old Tampa Bay between Tampa and St. Petersburg, Florida. The end of this cable, which projects possibly a foot from the surface, is frazzled out into a brush so that as an automobile p cable makes a ground contact with the frame of the car. This contact discharges the static electricity which may have been developed in the car due to its rapid motion, and thus obviates the unpleasant shock the driver and toll gate keeper would otherwise receive when exchanging money and ticket.

The cable company humorously refers to this user of their product as probably the "smallest consumer of the shortest commercial lengths" of their cable in th world.

Wood Alcohol as an Anti-freeze

A RECENT report published by the United States Bureau of Mines relative to the use of methanol as an anti-freeze for automobile radiators adds a strong note to the argument that a reasonable use of this chemical is not dangerous. This report represents work done under a co-operative agreement between the United States Bureau of Mines and the Carbide and Carbon Chemicals Corporation, the DuPont Ammonia Company, and the Commercial Solvents Corporation. The conclusions and recommendations contained in this report are as follows:

"1. Observations made by the Bureau of Mines have indicated that there is no danger of poisoning from the reasonable use of methanol as an anti-freeze for automobile radiators.

"2. The evidence that methanol poisoning has been caused by absorption through the skin is rare and inconclusive.

"3. Practically continuous exposure to low concentrations and short intermittent exposure to high concentrations of methanol cause no apparent harm; but, on the other hand, continued exposure to high concentrations will cause serious poisoning.

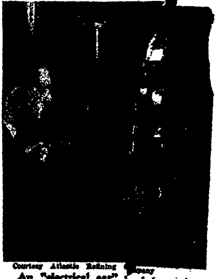
"4. All methanol, whether made by wood distillation methods or synthetic methods, or whether it is crude, refined, or highly purified, is poisonous when taken internally. It will cause serious poisoning, blindness, and possibly death when as little as 2 ounces is taken into the stomach.

"5. To avoid misuse it is recommended that in the future all anti-freeze methanol be brightly colored to enable garage tendants and the public to identify it methanol; and to warn against misuse, p ticularly for beverage purposes.

"6. The largest producers of metha anti-freeze label their containers so as the hazards of misuse methanol and also issue information instructions to garage attendants and consuming public warning against its use. It is recommended that these pre tionary measures be adopted by all ducers."

"Electric Eye" Measures Inte Stresses of Glass

A DEVICE which detects and me internal strains in glass was de by Dr. A. L. Duval D'Adrian at a meeting of the American Chemical Soc Dr. Duval is an expert in glass manufacture and was formerly consulting cers

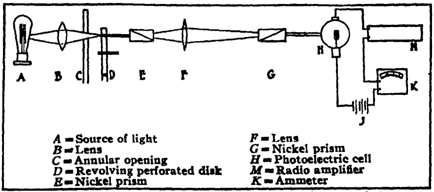


Courtesy Atlantic Refining pany

An "electrical ear" used in anti-knock research. The "mike" near the testing engine picks up the faintest whisper of a knock which, after a hundredfold amplification through high-pass filters and tubes, [illegible] on [illegible] meter dial engineer for the Illinois Glass Company.

In the apparatus invented by Dr. Duval, the magnitude of strain in a piece of glass is measured by the degree of deflection of the needle of an ammeter.

Referring to the diagram, "A" is a source of light, the rays of which are gathered in the lens "B," and pass through the orifice "C." These rays are interrupted by the revolving perforated disk "D," and then passed through the polarizing prism "E." The parallel rays are gathered by the lens "F," impinging upon the prism "G." Any rays passing through this second prism excite the photo-electric cell "H" and current set up in this cell is amplified by the radio amplifier "M" and registered in ammeter "K."



Schematic diagram of apparatus for measuring internal stresses of glass

To operate, the prisms are rotated to the point where the ammeter registers a slight positive reading. If a glass without strain is inserted in the stream of rays between "F" and "G," the ammeter will register a negative reading on account of the reduction in the volume of light caused by the glass. On the other hand, a glass which shows strain will give a positive reading depending upon the magnitude of the strain, as strained glass rotates the polarized light. A high-frequency current is generated in the photo-electric cell which is amplified by the radio amplifier. The instrument should have considerable use in the glass industry.—*A. E. B.*

Corn Harvesting by Machinery

IMAGINE if you can the modern wheat belt farmer attempting to harvest a huge wheat crop with the old-fashioned cradle. In this modern age such a thing would be unbelievable. Yet, until recently no relief from old methods of corn harvesting has been afforded the corn raiser. The corn grower has been forced, through no fault of his own, to harvest his crop largely with tools no less antiquated than the wood [illegible]

With the development of the Gleaner Baldwin Corn Combine, the corn grower will get a new deal. This new machine will cut, shell, clean, and bin the corn, and at the same time clear the field for the plow. The farmer completes the job in one operation and rides while he is doing it. The cost of doing this, according to tests before unbiased judges, [illegible] said to be a fraction over th[illegible] bushel contrasted to about 12 cents per bushel by hand methods.

As the machine [illegible] rawn through the corn field the rotary notched cutters shown in an accompanying photograph cut two rows of stalks at a time. As the stalks are cut they fall, or are carried, into the steel harvester pan. The rapidly revolving steel conveyor feeder conveys them directly into the cylinder. This cylinder shells the corn which is then transported to a cleaner. The stalks are kept in constant agitation as they pass through the separator to the ground.

The shelled corn is given the first cleaning by a blast of air from the separator fan. Final cleaning is a simple sifting process, and refuse that reaches the shoe is sifted and blown from the corn. The corn passes through the chaffers and an auxiliary screen and is then conveyed to a bin. Although no large amount of corn is cracked by the cylinder, provision is made for saving that which passes through the auxiliary screen. Power is supplied by a model-A Ford engine which is regular equipment on all Gleaner Baldwin Combines.

This Combine is convertible so that it will harvest wheat, oats, flax, barley, or other field seed crop.

Treatment of Burns

THERE is no injury so immediately painful [illegible] and no other injury so dangerous to life as a serious burn. Clinicians are likely to classify burns in three groups according to their severity, representing what are called first, second, or third degree burns. The classification has to do with the depth of the burn and the amount of surface destroyed.

There has been for many years an attempt to control the incidence of burns through proper care in industry and in the home, and the number of deaths from them is unquestionably decreasing. In Great Britain there were 251 deaths in the period from 1899 to 1903 in one large London hospital, as contrasted with 19 deaths in the period from 1924 to 1928. In the former period, there were 990 cases in the hospital, whereas in the latter there were only 286.

Among the reasons for the decline, according to Dr. Charles Donald, are the replacement of oil lamps and other liquid lights by the electric bulb, discontinuation of the use of flannelette as clothing, factory regulations, and better attention to the child in the home. In Great Britain there is a law making it a punishable offense to leave a child under seven years of age in a room with an unprotected fire!

The reason for the diminished mortality from burns is believed by Doctor Donald to be a better method of treatment of these conditions by the medical profession in recent years. It has been recognized from the first that one of the most important methods of control of the burn is to cover it up in order to prevent irritation of the portion from pain due to stimulation of the exposed nerve endings.

During the war, the para burns had great vogue. This involved pain [illegible] hich harden and formed a protective coating. Before the use of paraffin, it was a common custom in the home to cover the burn with oil or with a mixture of equal parts of olive oil and lime water or with any other good covering. While this represents good first-aid treatment, it is not the safe method of treatment for promoting cleanliness and healing. Burn ointments usually consist of a mixture of zinc oxide, boric acid, eucalyptus, vaseline, lanolin, and castor oil.

It has been recognized that the burned

A tra_r pulls the corn combine which harvests corn, shucks and shells it, and dumps the shelled corn into bins

Pointed deflectors turn the corn stalks in toward the rotating disks with sharp serrated edges which cut it easily

tissue may be absorbed by the blood and produce toxic changes in the body. Investigators have shown that a severe burn also produces anhydremia or drying out of the body, with thickness of the blood, and that it is important to get considerable quantities of fluid into the patient if he is to survive.

The most recently accepted treatment of burns is the tannic acid treatment. In this method, the first-aid treatment, which is usually a greasy substance, is removed by washing with benzene. Blisters and devitalized skin are removed with sterile instruments and the burned area is then sprayed with a 5 percent watery solution of tannic acid. This must be made up fresh, since it breaks down, on standing, to the less astringent gallic acid. It is customary where there is much emergency work involving the treatment of burns to put up the tannic acid in waxed envelopes, 1.5 grams or 23 grains of the tannic acid to be dissolved in one ounce or 30 cubic centimeters of boiled water in order to make a 5 percent solution. When there is a serious burn about the face, care must be taken to protect the eyes from the tannic acid spray. It is customary to spray the burns with the tannic acid solution every hour until a heavy brown or black crust is produced. The production of this crust makes it unnecessary to put on dressings and to remove them frequently, which is a painful procedure.

In mining copper, large masses of practically pure metal are often discovered. One of the largest on record is the "nugget" that was encountered on the 86th level of a Quincy Mining Company mine last year, and shown in the illustration. It weighed about 35 tons, was 30 feet long, 8 feet wide, and was 3 feet thick

If the burn is extensive, the person can lie on a bed. The bed clothing should not be permitted to touch the burned area. It is customary to cover the patient with a tent containing electric lights which will keep the patient warm and aid the drying of the secretions.

Obviously one of the chief dangers of burns is the infection of the wound and the intoxication from the burned area. This must be taken care of promptly by a physician who can take care of the indications as they arise. The treatment of burns can be resolved into prompt cleansing by antiseptic methods of all burns; the covering of superficial burns with some protective ointment, oil, or melted wax; and the use of the tannic acid spray for burns.—*M. F.*

"Tracks" for Motorists on Bridge

THE motorist's practice of weaving [illegible] and out of a traffic line is never enti[illegible] safe; on a bridge it not only is danger[illegible] but serves to retard traffic. For that rea[illegible] the upper deck roadway of the Queens[illegible] bridge connecting Brooklyn and Manha[illegible] New York City, will have three distinct tracks divided by safety guards 13 inches wide. This fact was recently announced by Commissioner Albert Goldman and Edward A. Byrne, Chief Engineer of the Department of Plant and Structures.

The tracks will actually take the form of gutters, each slightly over five feet seven inches wide, depressed two inches below the safety guards which separate the three lanes. At the end of the bridge the motorist is routed into these lanes in such a way as to eliminate as nearly as possible any crowding in any particular lane. Having once entered a lane the motorist cannot weave in and out of the various lines without bumping over the safety guards.

It is expected that this system will expedite traffic over the new upper deck roadway which will be completed and opened for traffic early next summer. It will accommodate 40,000 automobiles in 24 hours. The main deck of the bridge handles 90,000 cars a day.

The "R-100" Motor Car

SIR DENIS BURNEY, the designer of the British airship *R-100*, has built a remarkable motor car which made its appearance on the streets of London recently. Its streamlines are based on those of the airship, in order to counteract wind resistance, and it is claimed that the car will cut gasoline consumption by 50 percent. Due to the aerodynamic principles involved in its body design, at high speeds it scarcely touches the ground, with a consequent saving in tire wear. If a speed of 180 miles per hour could be attained the car would actually rise in the air. Another feature of the remarkable car is that the engine is situated at the rear as shown in the illustration below.

Castor Oil Increasing as Motor Lubricant Abroad

THE use of castor oil as a lubricant for automobile and airplane motors becomes more and more general in France. The cultivation of castor-oil plants has increased in Morocco and Algeria in the last three or four years. The results obtained have been very satisfactory and castor oil is used to an ever increasing extent.

The acidity of castor oil has been one of its chief disadvantages. Now, castor oil neutralized by triethylamine prepared for this purpose is used. The triethylamine is a viscous liquid formed by mixing primary, secondary, and tertiary amines and it can be used to counteract exactly the free acid in castor oil. The oil thus neutralized is washed with water, filtered, and dried. It has lost none of its lubricating properties and is indefinitely stable.—*A. E. B.*

Clothing and the Child

A BRITISH psychologist recently undertook an inquiry among 122 girls and 183 boys between the ages of 6 and 15, with a view to finding out their attitude toward clothing. A result of the study indicated that children up to about the age of nine look on clothing simply as being decorative and would probably, if free to choose, wear anything as long as the color is sufficiently brilliant. From the tenth to the twelfth year the desire for decoration increases and some attention is given to design and cut as well as to color. At this age, the child begins to be disturbed by convention which demands care for and consideration of clothing. As the girl grows older, she begins to sublimate her interest in her body on to the clothing.

The author finds that the motive of modesty is strongly considered in c

The engine in the tail of the so-called "R-100" motor car tion with clothes, so far as the girls in lower classes of society are concerned. Apparently the lower classes have not yet accepted the widely held opinion among higher classes that a lightly dressed body is not necessarily and deliberately immodest.

Children are particularly intolerant of tight or rough clothing, and complain particularly of too much heat. Evidently the

Power from Salt of Ocean?

REFERENCE has been made in these columns to the spectacular efforts of Georges Claude, French scientist, to produce power by utilizing the difference in temperature which exists between surface water and the water from the depths of the sea. Claude's pioneering experiments at Matanzas, Cuba, have been recounted at length in the daily press. The preliminary experiments have been adjudged very promising, and the inventor is convinced that he has led the way to a new and unlimited source of the world's power requirements.

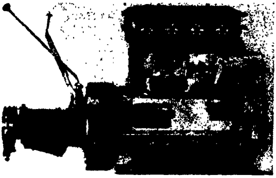
Now comes a new suggestion along analogous lines. Following the same general principles, it has been proposed in a recent report to the Academy of Sciences of France to use the differences of vapor pressure, not of warm and cold water, but of waters of different salt content. At the mouths of rivers, a large volume of fresh water is found immediately in contact with a large volume of salt water, and it seems possible, by means of a suitable apparatus built on principles similar to those demonstrated by Georges Claude, to utilize the difference in vapor pressures. No experimental work has yet been done to test out this proposal.—*A. E. B.*

An American Diesel-Engined Truck

A DEMONSTRATION of the possibilities of the Diesel engine in highway transportation was recently made when the Hill Diesel Engine Company installed one of their four-cylinder Diesel engines in a Reo Speed Wagon and transported a Diesel-electric generator set from their factory at Lansing to New York and established a record for low cost transportation that will probably stand for some time.

While the engine design follows closely recent automotive practice, it was developed mainly to meet the need for a light-weight, high-speed Diesel engine for auxiliary power on motorships, yachts, and other Diesel-powered craft, and for propulsion of smaller boats than have heretofore had the advantage of that safe and economical prime mover.

Finding it necessary to deliver to a yacht at New York one of the little generator sets in the shortest possible time, it was decided to power a truck with one of the engines and give it a reliability test and at the same time determine the adaptability of the Diesel engine to highway transportation. Accordingly, the gasoline power plant was removed from a one-ton Reo Speed Wagon and the Diesel installed in its place, using the same transmission and rear axle gear ratio of 5¼ to 1. The engine alone weighs 700 pounds, and the truck complete without load, 4300 pounds. The load weighed 2300 pounds, so the gross weight was 6600 pounds.



The four-cylinder Diesel engine manufactured by the Hill Diesel Engine Company with automotive transmission with which it was equipped before mounting in the truck. The run of the truck to New York provided a practical test of the Diesel engine in road service

After installation of the engine, the truck was given a few minutes' trial, loaded, and started on the long trip to New York. The fuel tank which had a capacity of 18 gallons was filled with Michigan oil, known as Zilwaukee fuel oil, having a gravity of 26 degrees Baumé.

The route taken was via Detroit, Toledo, Norwalk, Elyria, Barea, Bedford, Ravenna, and Warren, Ohio, then Sharon, Meadville, Waterford, thence through Scranton and Carbondale, Pennsylvania, to Middletown, New York, then down to Nyack, New York, where the load was delivered and installed on the yacht at Peterson's shipyard.

At Barea, Ohio, room for 10 gallons of fuel oil was found in the tank and this quantity was obtained at an ice plant at five cents per gallon. The engineer did not know the gravity of this fuel, but it was fairly heavy black oil purchased for use in a large stationary engine. The run was continued to Sharon, Pennsylvania, where a stop was made for the night, the distance for the day being 287 miles. The next day's run was to Youngsville, Pennsylvania, where 15 gallons of fuel oil were obtained at a flour mill at ten cents per gallon. The short run of 131 miles for this day is accounted for by a late start, several detours, and a considerable mileage of high crowned narrow roads which made slow going necessary with the rather top-heavy overload.

At Scranton it was thought best to replenish the fuel supply, but as it was Sunday, fuel oil was not obtainable, and three gallons of kerosene which had been used to wash out an engine base were obtained from a garage and five gallons of clean kerosene were obtained from a filling station. This filling carried the truck through to its destination with three gallons to spare.

This last day's run was 252 miles.

Total distance traveled	959 miles
Total fuel consumed	48 gal.
Miles per gallon of fuel	20
Weight of pay load	2300 lbs.
Ton-miles pay load	1102 miles
Ton-miles per gallon	23
Total cost of fuel	$3.72
Cost of fuel per ton-mile pay load	$0.003375

The return trip was made with 1200-pound load via Middletown, Binghamton, Elmira, Dansville, Hamburg, and Buffalo and thence, by boat, to Detroit, and by highway to Lansing. This return trip was shorter, and the cost of fuel per ton-mile pay-load was $0.00418.

It is believed that these results constitute a low cost record for highway freight transport, and further, that it is the first American Diesel engine powered truck to make a long distance service run.

The Diesel-engined Reo truck ready for the run to New York

Testing Vision of Future Drivers

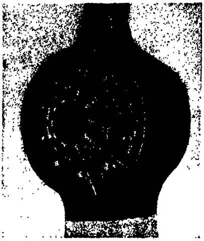
RECENT examinations given to applicants for motor vehicle operators' licenses in Connecticut show that about 15 percent of all those applying wear or need eyeglasses. Only about 52 percent of all appear to have perfect eyesight. About 1 percent are refused licenses because of poor vision. Eight percent are given restricted licenses, which permit them to drive only when wearing spectacles. Many applicants have been made aware of minor defects of vision. In a majority of cases these defects are corrected by the use of eyeglasses or some other means, and after re-examination the applicant is licensed to drive.

There is always a question as to how much a physical defect will interfere with proper driving. It is an interesting question, and one which comes before an administrator many times.

The answer seems to be, as applied in modern practice, that a person may be defective in almost any sense except sight and yet drive a car successfully. The theory or law of compensation applies. It appears that when one sense or faculty is deficient the others become more acute or more efficient.

It remains true, however, that good eyesight is essential in the operation of an automobile. All states which have examinations for prospective drivers carefully consider this qualification. Eyesight tests are common. Usually they are so adjusted that they will detect lack of v

make a person unsafe as an operator. Most of the tests will determine whether the person examined can distinguish a moving object within 200 feet. Few are discovered with such poor vision as that, but such persons do exist. In most cases the eyesight troubles can be corrected.—Robbins B. Stoeckel, Commissioner of Motor Vehicles, State of Connecticut, in the *United States Daily*.



Flexible propeller hub which was designed to avoid torsional vibration

◆

Itching Skin

IT has been said again and again that the skin is the mirror of the body. Recently John H. Stokes has been giving special attention to the effect on the skin of emotional and nervous states. He point out that itching of an apparently norma skin may arise from a submerged or repressed anxiety or desire. I also recognized that such itching have an underlying sexual stress or g. Quite frequently the person derives ure from or some

A Flexible Propeller Hub

SOLDIERS crossing a strong bridge may cause it to break down if the rhythm of their step happens to coincide with the natural vibration of the bridge. In the same manner, when the firing impulses of an aircraft engine happen to coincide with the period of vibration or rate at which the crankshaft twists back and forth when put in torsion, the twist of the shaft may become dangerously great. A shaft may be enormously strong and yet give rise to this dangerous phenomenon known as "resonance." Very often the resonance occurs at a low engine speed, say about 1000 or 1100 revolutions per minute, and once this speed is passed all traces of resonance disappear.

To cure resonance completely the period of vibration of the shaft should be very long, so that the oscillations of the shaft are always too slow to "get in step" with the firing impulses of the engine. The shaft should be less stiff to achieve this end. But to make a shaft less stiff may mean weakening it dangerously. The Royal Aircraft Factory in England claims to have found a solution of the problem. Whenever "resonance" is present, the shaft is left just as it is, but a flexible hub is employed.

A normal airscrew hub is employed, but it is free to float on the shaft. The propeller is driven by means of radial spring arms, the central boss of the arms being keyed to the shaft in the usual way. This reduces the stiffness of the system, slows down the period of oscillation, yet at the same time affects the strength not at all. —*A. K.*

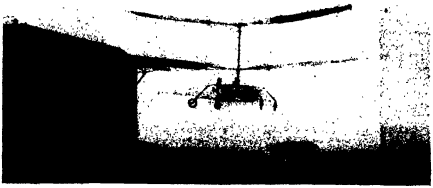
An Italian Helicopter

I thriller, entitled the "Jury of Death" we read of the city of Cayuga, do iated by gangsters who use helicopters, or "copt s a method of transportation. The rs" land on roofs and serve gangster police alike. It is a strange thing imaginative writers, whether novelists or newspaper men, seem convinced of the coming of the helicopter, while the technicians are very doubtful. In the D'Ascanio helicopter, described some-

press, all existing helicopter records for endurance, distance, and altitude have been broken, and the hopes of the helicopter exponents raised afresh.

The D'Ascanio helicopter has been flown at the Ciampino Nord Aerodrome in Italy, both in the open and inside an airship hangar.

It consists of a cruciform framework fuselage, surmounted at the centre by two large horizontal propellers, rotating in opposite directions. The propellers are really large wings, jointed at the roots, with elevators at the tips. By changing the angle of the elevators, the pilot can change the angle of incidence of the main blades. When the wings are set at a positive angle the craft ascends; when set at a negative angle, the craft descends. When the engine quits, the rotating airfoils act as a windmill and give the helicopter parachutal qualities.



The record-breaking D'Ascanio helicopter in flight

At each end of the fuselage cross there are small propellers, also rotating in a horizontal plane. By driving one or other of these small propellers the craft can be tilted and caused to proceed along any direction. Therefore extreme flexibility of movement is achieved.

The machine is a single seater weighing only 1750 pounds and powered with an 85 horsepower Fiat engine. During its tests, the D'Ascanio helicopter took off and landed in a circle 49 feet in diameter, and maintained steady flight at an altitude of 13 feet. The record for altitude was secured by a climb to a height of 59 feet, and the endurance record was broken by a flight of 8 minutes, 45½ seconds. During some tests, the machine flew "hands off" with perfect steadiness.

While these are only preliminary trials, they give great promise.—*A. K.*

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Barnaby on Gliding

LIEUTENANT RALPH S. BARNABY of the Navy Bure of Aeronaut distinguished

gliding as long ago as 1911 in self-instructed gliding flights. In August 1929 he soared for 15 minutes and 6 seconds at South Wellfleet, Massachusetts, qualifying as the first "first-class glider pilot" in this country. It was Lieutenant Barnaby who in January of last year launched his glider from the airship *Los Angeles* in flight over Lakehurst and reached the landing field, 3000 feet below in 12 minutes. He has now

is thoroughly in keeping with his knowledge and experience.

To glance through this book is to learn what a rich and complex art gliders and glider construction have become. There are now primary gliders, secondary training gliders, and soaring planes of wonderful delicacy and efficiency. There is a whole theory of gliding in being. Gliders can be launched off a hill, by towing behind an automobile, by use of a ground crew, and by means of an automatic shock cord. The phenomenon of soaring in an up current, when the [illegible] a suitable hill or ridge, is well understood.

Now students of the art are delving into soaring in "thermic currents." These are vertical currents caused by heated air rising and cold air descending. Variations in radiation from the sun and the nature of the ground cause certain bodies of air to become heated and ascend. For example, the sun shining on a plowed field will heat

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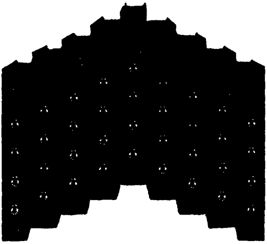

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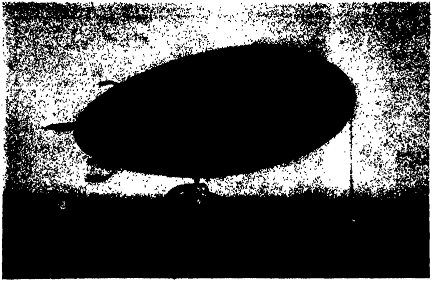


The Heinen airship moored to a light collapsible mast

the air above it very rapidly. Cool air blowing in from the water will be warmed by the land and will rise. Soft, smooth, cumulus clouds, with their towers and valleys, are the tops of such rising currents of air. The warm air rising bears moisture with it. As the air reaches higher altitudes it cools. Cool air will not hold as much moisture as warm air. It condenses in the form of the cumulus clouds. It was by soaring under one of these clouds, whose origin is so simply explained by the author, that Robert Kronfield, at the Wasserkuppe (Germany) Meet in 1929, was able to soar to a height of 7000 feet, and by gliding from cloud to cloud continued his flight for nearly 100 miles, an achievement which appears almost miraculous to us.

While Barnaby is an enthusiastic glider pilot, he strikes a conservative note in a chapter on "The Future." "Gliding on level ground or even from a moderate hill, launched by shock-cord, palls after a few flights. It is all very well for beginners but even the wildest enthusiast will tire of it before long. Automobile towing to higher altitudes from which one may enjoy a prolonged glide with easy turns back to the ground will carry things along a bit further. The real fact remains that the *ultimate goal of gliding is soaring* and unless soaring terrain is available, gliding as a sport is bound to wane."

There are many good soaring sites to be found. Cape Cod, Massachusetts, Point Loma, California, Uniontown, Pennsylvania, and Elmira, New York, have already shown their possibilities. But enthusiastic promoters of glider clubs and schools must take all the facts of the situation into account, and that is one of the real services rendered by this splendid book.—*A. K.*

A Sportsman's Airship

WE are accustomed to think of airships as craft of huge size, with millions of cubic feet of gas capacity, a number of powerful engines, and a range adequate for transoceanic travel. Captain Anton Heinen, former Zeppelin pilot and employed as a practical expert by the United States Navy during the construction of the *Shenandoah*, is of the opinion that there is also scope for the small airship, that the small airship has a number of industrial possibilities, and that it is an excellent craft for the sportsman owner.

He is courageously endeavoring to prove his case by building and flying the *Heinen Air Yacht*, one of the smallest airships on record.

The specifications of the *Air Yacht* are interesting. The overall length is 104 feet, maximum diameter 27 feet, length of car 22 feet. Inflated, the ship has a height of 39 feet; deflated, it is only nine feet high. The gas capacity is 39,700 cubic feet. The total weight empty is 1700 pounds. The total lifting capacity is given as 2700 pounds, which postulates rather more than 60 pounds lift per 1000 cubic feet of gas. The airship is powered with a Brownback-Tiger radial, air-cooled, six-cylinder engine of between 90 and 100 horsepower. The maximum speed of the airship is estimated at 65 miles per hour with the engine working at 1700 revolutions per minute.

When inflated with hydrogen, the useful load is about 860 pounds, including one pilot, three passengers, and enough gas for 250 miles flying. With helium the useful load is only 700 pounds because of the higher specific weight of the gas its reduced lift.

A pamphlet describing the airship gives some interesting figures on expenditures for fuel and gas.

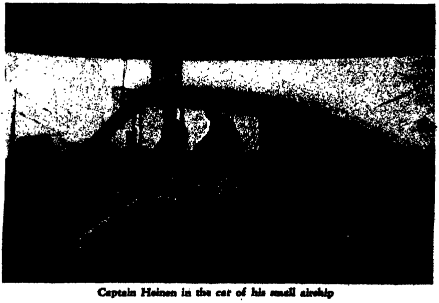
The consumption of lifting gas is estimated at 1 percent of the gross volume per every 24 hours of operation; in other words a loss of some 400 cubic feet a day. The gasoline consumption is given as six gallons an hour. The cost of hydrogen, furnished in 200 cubic feet containers by commercial plants, is $1.15 per 100 cubic feet. Helium is much more expensive, six to eight dollars per 100 cubic feet, but of course this gas can be purified and used over and over again. (See page 56, January 1931, SCIENTIFIC AMERICAN.)

These figures certainly do not look terrifying, although the maintenance of even a small airship is an expensive matter.

Airships are classified generally in three types—rigids, semi-rigids, and non-rigids. In the rigid there is a complete internal structure of duralumin girders and steel wires, one of the most complicated and refined structures known to the engineer. In the *semi-rigid*, there is a combination of a rigid keel with tension forces taken by the fabric covering. In the non-rigid airship such as Heinen's, there is no internal structure whatsoever; reliance is placed entirely on internal pressure for maintaining the form of the airship.

That internal pressure alone, with nothing but flexible fabric, can constitute a structure, may seem puzzling at first. The airship has its lift distributed, its loads concentrated. Therefore it has the character of a beam. How can a flexible material provide the characteristics of a beam, which we associate with steel girders? If a beam will bend, surely the flexible fabric will buckle either at the top or the bottom, depending on how the loads are distributed? The answer is that the internal pressure, a little higher than the surrounding atmospheric pressure, puts the whole of the airship fabric in tension. Therefore any compression forces which come on to the upper part of the fabric are neutralized by the tension and the airship not only preserves its form but is capable of supporting considerable bending moments.

The reader may ask how this internal



Captain Heinen in the car of his small airship

The answer lies in the conventional, but thoroughly effective ballonet and scoop system. At the lower part of the bag is a collapsible air compartment known as the ballonet. As the airship rises when ballast is thrown overboard, the helium or hydrogen gas in the main compartments expands, and the airbag collapses. When the pilot wishes to descend he releases a little gas, and as the helium or hydrogen contracts, a scoop above the pilot's head is filled with air under pressure by the slipstream of the propeller. From the scoop the air passes through a pipe to the ballonet, and thus with the aid of two automatic valves, one in the main gas compartment and one in the ballonet, a certain excess pressure is always maintained.

At the bow, where the maximum aerodynamic pressure of the air is exercised when the ship is in flight, special curved nose-battens also help to maintain the form of the ship.

The weight of the airship car must be carefully transmitted to the fabric and the load should not be too localized in its application. A number of cables are carefully arranged to carry the weight of the car, with the pull in each cable subdivided into the finger patches so that nowhere are excessive pulls applied to the fabric itself. The system of support can be seen in one of our photographs.

The construction of the airship is novel *in that it resembles* an airplane fuselage with undercarriage. The wheels are castorable, which is as it should be, since the airship may be required to move sideways on the ground. Another photograph illustrates the car, with the genial Captain Heinen himself in the front compartment. Incidentally this photograph shows very clearly the air scoop at the front of the car, and the air pipe leading up to the ballonet. At the front is the pilot's compartment with windows in all directions. In rear is the passenger cabin, and aft is the gas tank.

We are informed that the collapsible mooring mast to which the airship is shown attached is surprisingly light and effective. It is claimed that with the aid of this mooring mast a ground crew of two men is all that is necessary to handle the airship.

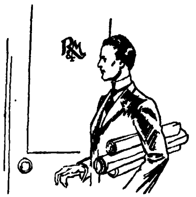
Experience alone will show whether a small airship of this type will prove useful as a vehicle of either pleasure or business. The Heinen company makes out at least a plausible case for its use as a pleasure craft, and also points out likely possibilities for passenger carrying, sightseeing, advertising, poison spraying in agricultural work, and for transportation purposes in rough and inaccessible country, where even the airplane may fail.—*A. K.*

Flight in the Stratosphere

SOMEWHAT to the disgust of the Junkers Aircraft Corporation, of Dessau, Germany, there have appeared newspaper accounts of a novel craft to fly at a mean altitude of 35,000 feet, and to cover the distance between Berlin and New York in a few hours, with a flight speed of between 500 and 800 miles an hour.

Very little authentic information is available on this plan of the Junkers Company; therefore we can give our imagination full scope in considering this new airplane.

(Please turn to page 131)



Who said it wouldn't "WORK"?

IT IS a matter of record that less than thirty years ago most of the electrical devices that make life so much more pleasant today existed only in men's dreams—ideas that wiseacres said would never "work." In that dawn of the electric age many a world-boon might have died in the bud, or languished for years, had not one electrical manufactory had the pre-vision to throw open its laboratories to the "visionaries." To Robbins & Myers at Springfield there came a long procession of ideaed men—and what tremendous ideas they had! Many great industries of international importance today are the fruits of those ideas. And millions of homes, offices, stores and factories are now enjoying the labor-saving, time-saving, services of these "wild-idea" inventions which were first made to "work"—*commercially*—with R & M power units. Which may explain why you so often hear the advice, "If your problem is electrical, take it to Robbins & Myers."

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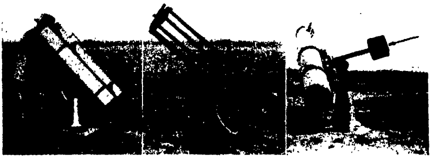
FANS, MOTORS, HAND AND ELECTRIC HOISTS AND CRANES

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

HARD times do not seem to have depressed the amateur telescope making "industry" There never before have been so much interest in it, so much demand for the instruction book "Amateur Telescope Making," and so many telescopes made We are 'way behind on publication of descriptions sent in by workers and find we have 28 on hand as we begin this month's make up of the department It looks almost as though people who were temporarily out of work at last had found an opportunity to tackle a job which previous busyness had prevented them from doing At such a time telescope making provides a good way to keep from going crazy at any rate, though our office cynic says it is a special form of insanity in itself However, "the other fellow's" pet hobbies always have been just a little bit crazy It's all a matter of point of view Anyway, with some 7000 of us addicts all gone crazy together, why should we worry about cynics? Let our wives, relatives, and friends rave about our disease and go play bridge if they wish, we shall head for the cellar workshop, crawling out of our hole at midnight or only when the coast is entirely clear Many a worker has pleaded an imaginary job "that would suffer if put off," in lieu of a dreaded social obligation Telescope making is a fine alibi



Mr. Hanson with his binocular; also his 10-inch and 12-inch reflectors

WELL, here are some of the descriptions mentioned above

Something original if not unique, a reflecting binocular, is the product of Hilmer Hanson, R F D. 5, Holdrege, Nebraska Let Mr Hanson describe it, noting the photograph and sketch (as drawn by him) on this page

"The mirrors of the binocular have a focal length of 54 inches Estimated magnifying power with the pair of eyepieces used is about 65 diameters. One advantage of this telescope over a monocular is, of course, that it enables one to view objects with both eyes It gives an admirable view of an object such as the full moon The stereoscopic effect on terrestrial objects up to a mile or so is a great deal exaggerated It gives one a sense of position of the objects viewed, though these objects are reversed and inverted

"The method of grinding and polishing two six inch mirrors to the same focal length was as follows Both mirrors were ground alternately on one tool In rough grinding the mirrors were changed on the tool once on each wet, and in the finer stages they were changed several times in a wet The polishing was done somewhat in the same manner as in the grinding Only one pitch lap was used

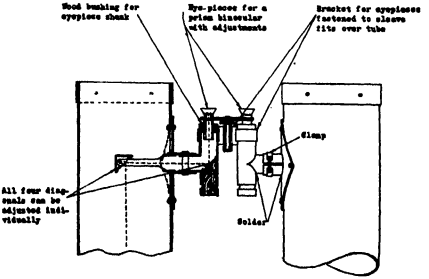
"The mirrors were tested and figured individually with the knife edge, but simultaneously with binocular eyepieces This test was not difficult to set up, and should prove quite valuable in determining the focal length of binocular mirrors Although the test was not made before the mirrors had been brought to approximately the same figure, it showed them to have the same focal length on the first trial The test was very interesting as the image could be viewed with both eyes and by manipulating the eyepieces in certain ways it was possible to examine the images of the pinhole individually, and compare them with one another When viewed as one image with both eyes the pinhole has the appearance of solidity The performance of this telescope is good and gives a wonderful binocular view of the heavenly bodies It was not much more difficult to make than an average reflector

"The pedestal is a half of a rear axle housing A brake drum is used for R A circle and a protractor for declination. A slender tube without lens, mounted on the telescope, is used for sighting"

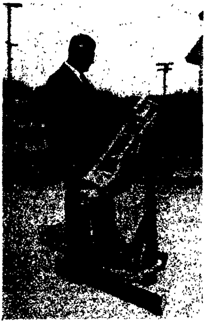
Mr Hanson also made two single tubed reflectors of which photographs are reproduced He writes concerning one of them

"The open tube telescope is a 10 inch with a focal length of 79 inches The polar axis is a heavy spindle with bearings and hub, from the front wheel of an automobile The fork of the telescope is fastened to a plate welded to the spindle body The tube of the telescope has a counter weight at the bottom end, and there is also enough clearance between the bottom of the tube and the fork to permit one to view the Pole Star, or to reach any part of the sky The adapter tube, diagonal, and eyepiece are all in one unit which can be revolved in the support so that no neck craning is necessary The whole telescope can be moved about on its casters This open tube telescope was made with the one purpose in view—to improve on seeing, and as compared with the same mirror used before in a metal tube, a marked improvement, with steadier seeing, is noticeable"

JAMES A McCARROLL, 521 Palisade Avenue, Teaneck, New Jersey, an archi

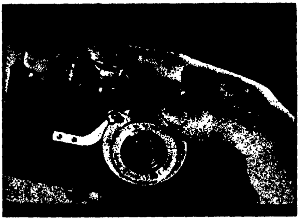

Wood bushing for eyepiece shank
Eye-pieces for a prism binocular with adjustments
Bracket for eyepieces fastened to sleeve fits over tube
Clamp
All four diagonals can be adjusted individually
Solder

Mr. Hanson's self-explanatory drawing of the eye end of his binocular tect, has turned his natural inclination into a structure of unique design for supporting his six-inch mirror. He writes: "After grinding, polishing, and figuring the mirror twice I obtained very satisfactory results. The tube is made of thin galvanized leader pipe and the hexagonal pieces around it and the lengthwise slats are of wood, the latter being for protection. The convex attachment to the bottom of the wooden cell is a ten cent aluminum bowl partly filled with plaster of Paris, and is mainly for making the tube balance at the desired point.


Mr. McCarroll and reflector

"The diagonal is a glass mirror and the eyepiece a single lens from an old telescope, having a focal length of about an inch and a quarter. All the optical parts are completely adjustable and easily removable, which would seem to be a necessity. The finder is a 1¼-inch metal tube with a 3/16-inch hole in a stop at the eye end and a half inch stop opening at the other. Having no place to set an equatorial mounting permanently I made the 'revolving post' altazimuth type shown in the photograph and this has proved satisfactory. By attaching wooden rings and slats to the light sheet metal tube most of the subsequent operations were simple woodworking ones. The instrument weighs 53 pounds and the total cost was less than 30 dollars. I consider my small outlay in 'Amateur Telescope Making' one of the best investments I ever have made, as it has provided me with a hobby which from all indications will furnish me with a fascinating indoor and outdoor sport for the rest of my life—at very little expense."

WE learn of some very definite signs of life in Pittsburgh where the enterprising amateurs are organized as "The Astronomical Section of the Academy of Science and Art of Pittsburgh," Leo J. Scanlon, Secretary-treasurer, 1405 East Street, N. S. Pittsburgh, Pennsylvania. They have worked out an aluminum observatory having original features. The story is too long for our available space but later we may find place for a part of it.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CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Directory of Officials and Organizations Concerned with the Protection of Birds and Game, 1930 (Miscellaneous Publication No. 92, United States Department of Agriculture) was compiled by Talbott Denmead and Frank G. Grimes. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

The Attempt to Define Aggression (International Conciliation No. 264, November 1930) by Clyde Eagleton is an attempt to clarify ideas on this important subject and to bring together the various proposals. *Carnegie Foundation for International Peace, 44 Portland St., Worcester, Mass.*

fully describes a
recording and
Brown Instrumen
Pa.—Gratis.

Buildings gives valuable information on a new problem in construction. *Robert W. Hunt Co., 2200 Insurance Exchange, Chicago, Ill.—Gratis.*

Biology of the Voles of New York (Roosevelt Wild Life Bulletin, Volume 5, No. 4) by Robert T. Hatt is a scientific study of meadow mice and related species, detailing their value, the damage they do, and how to control them. There are a number of illustrations including a colored plate. *The Roosevelt Wild Life Forest Experiment Station, Syracuse, N. Y.—$1.00.*

The Maritime Provinces, Canada, gives a short description of the developments in New Brunswick, Nova Scotia, and Prince Edward Island. The wealth of these provinces has been overlooked during the growth of western Canada and the industrial expansion in Ontario and Quebec, and it is only now that they are receiving the recognition which their resources deserve.—*Natural Development Bureau, Ottawa, Canada.—Gratis.*

Civil Engineering (October 1930, Vol. 1, No. 1) is a new monthly magazine published by the American Society of Civil Engineers and is a great forward step as it deals with those interests of civil engineering which could not be covered in the more technical *Proceedings* which will, of course, be continued. The style is more facile than was heretofore possible. It is beautifully produced with adequate illustrations.—*American Society of Mechanical Engineers, 33 W. 39th St., New York City.—$5.00 a year, single copies 50 cents.*

survey service of current bulletins two years ago, readers and publishers of bulletins alike have expressed their thanks. When letters of appreciation are received in ever-increasing numbers from such distant lands as New Zealand, Japan, and South America, naturally we feel that our pride in this section of the *Scientific American* is justified. To make this page of greater value to our readers, the editor shall be glad to consider for review papers and bulletins on any phase of science, engineering, or industry. However, we do not wish ordinary catalogs, and we will not mention what is obviously propaganda.

Material submitted should give full information as to where obtainable and the price, if any, so that the reader may obtain copies directly without unnecessary correspondence. — *The Editor.*

Growing Trees for Forest Planting in Montana and Idaho (Circular No. 120, U. S. Department of Agriculture) by D. S. Olson is a fully illustrated monograph on the subject. *Superintendent of Documents, Washington, D. C. — 25 cents (Money Order).*

Why Some Wood Surfaces Hold Paint Longer Than Others (Leaflet No. 62, U. S. Department of Agriculture) by F. L. Browne gives the fundamentals of painting characteristics, when to repaint, and so on. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

The Torsional Effect of Transverse Bending Loads on Channel Beams (Bulletin No. 211, Engineering Experiment Station, University of Illinois) by Fred B. Seely, William J. Putnam and William L. Schwalbe gives the result of many experiments. *Engineering Experiment Station, University of Illinois, Urbana, Ill.—35 cents.*

Musical Capacity of Adults Repeated After Musical Education by Hazel M. Stanton and Wilhelmina Koerth is a study of retest scores and ratings in the Seashore Measures of Musical Talent after three years of musical education in the Eastman School of Music, The University of Rochester. Valuable for all music teachers—*Department of Publications, State University of Iowa, Iowa City.—35 cents.*

Precision Wire Wound Resistors is a useful piece of literature dealing with such units and how they may be applied to measuring instruments. *International Resistance Co., 2006 Chestnut St., Philadelphia, Pa.—Gratis.*

Nickel Alloy Steel Products. A directory of manufacturers, fabricators, and distributors of nickel-alloy steel products. The carefully annotated list is very imposing for a comparatively new industry.—*The International Nickel Co., Inc., 67 Wall Street, New York.—Gratis.*

The Final Settlement of the Reparations Problems Growing Out of the World War (International Conciliation, September, 1930, No. 262) gives the Protocol with Annexes approved at the Plenary session of the Hague Conference, August 31, 1929, and agreements concluded at the Hague Conference, January, 1930. There are 197 pages of text.—*Carnegie Endowment for International Peace, 44 Portland St., Worcester, Mass.—5 cents.*

Photo-Electric Cells A

ns. A 235-page unbound book c taining 31 scientific papers delivered before the Physical and Optical Societies. *The Physical and Optical Societies, 1 Lowther Gardens, Exhibition Road, London, S. W. 1, England—$3.12.*

Washing, Cleaning, and Polishing Materials (Circular of the Bureau of Standards, No. 383). The information conveyed here is out of all proportion to the nominal charge. The definitions are authoritative and the bibliographical references are excellent.—*Superintendent of Documents, Washington, D. C.—10 cents (coin).*

Aviation Training (Aeronautics Bulletin No. 19, U. S. Department of Commerce, Aeronautics Branch) is a pamphlet intended to acquaint those who are contemplating entering the field of aeronautics with the methods of acquiring training and also some of the opportunities for employment. It is filled with valuable hints. *Aeronautics Branch, Department of Commerce, Washington, D. C.—Gratis.*

A Study of Slip Lines, Strain Lines, and Cracks in Metals Under Repeated Stress (University of Illinois Bulletin, Vol. XXVII., No. 40, June 3, 1930, Bulletin No. 208) by Herbert F. Moore and Tibor Ver gives much valuable information on the fracture of metals under stress. Profusely illustrated.—*Engineering Experiment Station, University of Illinois, Urbana, Ill.—35 cents.*

THE SCIENTIFIC AMERICAN DIGEST

(Continued from page 127)

First of all, there is the question of a power plant. The ordinary plane loses speed as it goes up to high altitude, because, as the altitude increases, the density of the air decreases also, and a smaller amount of fuel only can be burned in the cylinders of the engine. This difficulty is obviated by applying a supercharger to the aircraft engine. This supercharger is generally a centrifugal compressor, or a Roots blower driven either by gearing from the main engine, or by a gas turbine which is itself propelled by the exhaust of the engine. The supercharger supplies the engine with air of atmospheric density; therefore the power of the engine is maintained up to heights exceeding 30,000 feet.

Granted that the power of the engine can be thus maintained at altitude, what is the effect on the speed of the airplane? As the plane rises to altitude it must fly at a higher angle of incidence. Owing to the lesser density of the air, the higher angle of incidence is needed to provide more intrinsic lifting capacity. At ground level and at top speed the wing flies at very low incidence, zero degrees, or even at small negative incidence to the wind. With this altitude-plane it would be possible to fly at 35,000 feet at four degrees incidence, provided the power is maintained by the supercharger. Now, it so happens that an airplane wing is much more efficient at four degrees than it is at very small angles; therefore, the altitude-plane, when flying in rarefied air of great heights, will be functioning much more efficiently than in high speed condition at ground level. It follows from this that with power maintained constant the plane can fly some 30 [illegible] it height than [illegible] a level.

[illegible] anted that the Junkers Company, taking advantage of all of the aerodynamic refinements now at our disposal, can design [illegible] which will be as efficient and have as powerful an engine as a Schneider Cup racer, which can attain 400 miles an hour at ground level (unofficial reports have it that certain British seaplanes have already attained this figure) and if we add between 30 or 40 percent to the 400 miles an hour by altitude flight, then a speed of 600 miles an hour at 35,000 feet is not beyond the realm of possibility.

There is still another device besides the superchargers which has to be embodied in our altitude-ship, namely, the variable pitch propeller. Since the propeller at altitude has to work in a rarer medium, and at the same time has to propel the airplane at a greater speed than at ground level, the ordinary fixed blade propeller will work very inefficiently at height. We must have a variable pitch propeller whose pitch can be considerably increased for the journey at 35,000 feet height.

Even this does not end the list of engineering innovations which have to be provided. At very high speeds parasite resistance becomes extremely important, far more important than increase in weight.

The modern airplane with its beautiful streamline fuselage and finely tapered wing has one remaining item the resistance of which can be eliminated—the landing gear. There is little doubt that in the Junkers altitude plane the landing gear will be retracted and hidden away, either in the fuselage or in the wings, just as a bird withdraws its feet when flying at great speed.

This finishes the engineering difficulties, which have to do mainly with the construction of the airplane, but there is still to be considered what happens to the passengers and pilots at great altitudes. The passenger cabin will undoubtedly have to be made in the form of a completely enclosed metal shell, capable of resisting a difference in pressure between the outside and the inside of the cabin. The interior of the cabin will have to be supplied with air, compressed so as to bring it back to the pressure and density that we are accustomed to in our every-day life. Further, neither the pilot nor the passenger can be expected to be entirely comfortable if he is to be bundled up in electrically heated clothing during the comparatively long flight. The exhaust of the engine will therefore have to be utilized carefully so as to maintain an equable temperature inside the cabin.

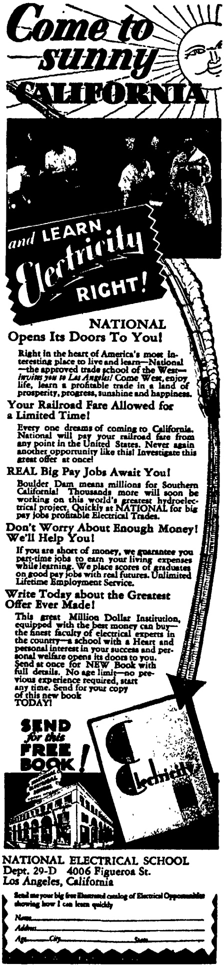
There is one very helpful feature in the German constructor's plan. At high altitudes, owing to the fact that the earth rotates from west to east there is a constant high wind blowing from east to west. Scientists calculate that this wind may have a magnitude of 100 miles an hour, or even more. In that case, in flying from Berlin to New York, the adventurers of the upper air would have a powerful aid to speed.

We have seen the Germans build successfully large rigid airships, the largest flying boat in the world, and rocket-propelled airplanes. Many people of all countries have thought of the altitude plane. It is not impossible that the Germans may in this field also lead the world by their boldness of conception and execution.—*A. K.*

Cause of the Common Cold

FOR at least 20 years there has been intensive research into the question of the cause of the common cold. Among the most recent reports is one emanating from investigators in New York City, including Doctors G. S. Shibley, K. C. Mills, and A. R. Dochez, who have carried out research on young chimpanzees. They first determined the bacteria usually found in the upper respiratory tract of the chimpanzee, and concluded that chimpanzees are susceptible to the human type of infection and that the symptoms suffered by these apes resemble those suffered by human beings who catch cold. The animals were placed in strict quarantine, everything used by them was sterilized and strict surgical sterility was observed among the workers who came in contact with the animals.

Washings were made from the noses of persons suffering with colds. After each filtration this material was injected into the nostrils of the chimpanzees. Twenty-eight chimpanzees were inoculated, 20 with material obtained from patients in acute stages of the common cold and eight with material obtained from normal individuals at a season of the year when colds were at their lowest incidence. Four animals were excluded because they had recently suffered



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Power house at the government's helium plant in Amarillo, Texas, showing the gas engine units in the foreground and the compressor units in the background

from respiratory infection. Of the remaining 16, seven contracted experimental colds, usually within from 36 to 48 hours after inoculation. The animals developed lassitude, loss of appetite, and a mucous nasal discharge followed by nasal obstruction, sneezing, coughing, and sometimes sore throat.

Following these experiments on apes, the authors attempted transmission of colds from man to man. Volunteers were secured and inoculated exactly as were the apes. Nine experiments were completed and in four instances colds were successfully transmitted.

As a result of their investigations, the authors conclude that the contagious cold in human beings is caused by an invisible uncultivable, filtrable agent which probably belongs to the group of so-called filtrable viruses.—*M. F.*

Helium Plant Celebrates First Birthday

HELIUM, the non-inflammable gas used for floating lighter-than-air craft, is produced commercially only within the United States. The government's newest helium plant, located on an 18-acre site, some seven miles from the town of Amarillo, Texas, has just completed its first fiscal year's operation and a very interesting description of the unique operations appeared recently in *Chemical and Metallurgical Engineering*, written by C. W. Seibel, supervising engineer of the United States Bureau of Mines. The Bureau of Mines obtained control of the gas rights of a virgin gas field comprising some 50,000 acres. The gas reserves of this area are adequate to supply the Army and Navy with helium for many years. Not only does this field produce gas containing nearly 2 percent helium but the pressure is such that there is no need to compress further the gas in the process of helium extraction. The field is connected to the plant with a six-inch welded steel pipe line about 12 miles in length.

Cryogenic laboratory in the helium plant showing gas analysis apparatus. Here is housed the equipment used in gas research problems which usually involve low temperatures

The natural gas which the plant processes has a rather high carbon-dioxide content for fuel gas—about one half of one percent—and it is necessary to remove this constituent before the helium can be separated. Failure to do so would result in solidifying the carbon dioxide in some of the tubing and thus putting the plant out of operation.

The removal is accomplished by scrubbing the gas under pressure with a 6 percent solution of caustic soda. This scrubbing is effected inside a four-inch pipe having a total length of about 1000 feet, and through which all of the incoming gas to the plant must pass. The caustic soda solution is forced into the gas stream with the aid of a plunger-type pump. After the gas and liquid have traveled the length of the pipe they are separated by a special trap.

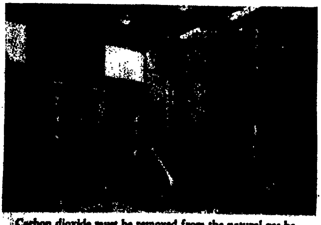
The gas, still under pressure, is then conveyed to the building in which the helium is actually removed. The gas coming to the separation building consists chiefly of methane, ethane, nitrogen, and somewhat less than 2 percent of helium. In order to separate the helium and get it in a nearly pure state, it is necessary to cool the mixture to an exceedingly low temperature. The fact that the gas reaches the plant from the field at a pressure of something more than 650 pounds obviates the necessity of further compression. Practically all of the gas which enters the plant at ordinary room temperature is cooled to about 300 degrees below zero, at which temperature the helium is separated from the resulting liquid-gas mixture.

The helium finally produced has a purity of from 40 to 80 percent, depending on the method of operation. It is sent to a gas holder and from there re-compressed, carefully dried over lump caustic soda, and sent through another similar cycle, by which its purity is stepped up to about 98 percent.

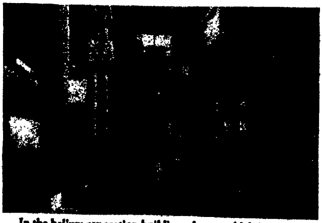
The helium is shipped from the plant to the Army and Navy flying fields either in tank cars or small cylinders. Each of the helium tank cars consists of three or more large heavy-walled, seamless steel tanks mounted on railroad trucks. These tank cars, filled to a pressure of 2000 pounds per square inch, hold about 200,000 cubic feet of free gas.—*A. E. B.*

Odorless Varnish

REFRIGERATOR manufacturers have been working for the last three or four years to obtain a synthetic paneling material for the construction of their "boxes" because of the desirable qualities of laminated board. The use of synthetic materials of the bakelite type, however, was limited as they were not satisfactory when



Carbon dioxide must be removed from the natural gas before the helium can be separated. The pumps shown handle the caustic soda solution used to absorb carbon dioxide



In the helium separation building, the gas which is used in the airships of the United States is separated from the natural gas by freezing out all the other constituents brought into close proximity to foodstuffs, because of the slight residual traces of phenol odor which were readily absorbed by almost any type of fatty produce, such as butter. A new odorless varnish has contributed to the solution of this problem and the use of laminated board is now possible for manufacturers of refrigerators and in work of a similar nature. During the past year the use of laminated stock for hotel paneling, desk tops, radio panels, window decoration, and so on has been quite common and on the increase.—*A. E. B.*

Hupmobile Has Free-wheeling

FREE-WHEELING will be included as standard equipment on every new model produced this year by Hupmobile, according to information received by us from the Hupp Motor Car Corporation too late to be included in our review of 1931 cars on page 860. In making this announcement, Hupmobile is in the unique position of having free-wheeling not only in all its new eight-cylinder cars, but in its new six-cylinder models as well.

As adopted by Hupmobile, free-wheeling is simplicity itself. In free-wheeling, the clutch may be used to shift into all speeds. It must be used as in ordinary driving when shifting into reverse and low speeds and from low into second speed. However, under certain operating conditions, it is easily possible to shift from second to high or back from high to second speed in free-wheeling without using the clutch. When free-wheeling is not used, the clutch must be used to shift into all gears.

Hupmobile's free-wheeling consists of an over-running or one-way clutch. This clutch permits the gears to remain engaged in either second or high speed while the car is rolling forward under its own momentum and the engine is idling at a speed equivalent to from six to eight miles an hour. In operation, this clutch operates in a manner similar to the well-known bicycle coaster feature, the stem-winding watch, and the winding key of a portable moving picture camera, in that it turns freely in one direction and engages when the power is applied for an increase in speed.

Geographical Localization of Diseases

SINCE the time of Noah Webster's famous epidemiology, it has been recognized that death rates from some diseases are frequently higher in some sections of the world than others. Thus, the death rate from diabetes diminishes as one approaches the equator, and, in general, increases in the opposite directions. Dr. C. A. Mills has suggested that this increase in the cooler and more stimulating regions probably results from an exhaustion effect of overstimulation by the highly changeable climate. He did not find a sufficient correlation between the rate of the consumption of sugar and the death rate from diabetes to indicate a cause and effect relationship.

Doctor Mills has also given special attention to the geographical distribution of pernicious anemia, goiter, Addison's disease, and angina pectoris. He finds that the same countries that have such a high and increasing death rate from diabetes are also the ones afflicted with pernicious anemia. Near the equator, both diseases are much less fatal. The distribution does not appear to be racial, since Italy, Uruguay, and Iceland are mainly populated by the white race, Ceylon by Indians, and the Philippines and the Straits Settlements by the yellow and brown races. Nevertheless, the distribution of the diseases follows the geographical rather than the racial distribution.

It has been pointed out again and again that simple goiter occurs more frequently in regions in which iodine is not prevalent in the soil, in the drinking water, or in the food used by the people. Exophthalmic goiter represents possibly the effect of overstimulation of the metabolic rate. In the United States there is a lower death rate from this cause in the southern states as compared with the northern. There is a low rate in all states having a comparatively extensive contact with the Atlantic Ocean, while the Pacific Coast states show a high rate.

Doctor Mills also points out that during almost two years' hospital experience in China, he saw little advanced hardening of the arteries or its complications in the Chinese people. Blood pressure in the Chinese ranges considerably below the level common in the northern United States, and the basal metabolism and general scale of physical activity are correspondingly low.

The death rate from angina pectoris in the southern states is about half that of the northern states. The rate among the Negroes is lower than in the white population in the south, whereas the rate of the white population in the south is only two thirds of that of the north. So far as the Negroes are concerned, their death rates from pernicious anemia and angina pectoris are lower than that of the white population; for the acute infectious diseases and for tuberculosis, they are higher. *—M. F.*

Gas Helps Railroads Fight Snow and Ice

THE Chicago & Northwestern Railroad recently completed the installation of gas burners in the intricate track approaches to its passenger station in Chicago as a weapon against the snow and ice of winter blizzards.

The gas burners are placed underneath switches and other track work that must be kept free from obstruction. When the storms come, the burners are lighted. They warm the steel just enough to melt the snow and ice.

Gas heat to keep railroad switches clear in winter was first proved practicable in Chicago last winter when, during the worst blizzard in ten years, the Union passenger station track approaches were kept free from obstruction by the burners. Several hundred men were required to sweep and shovel snow at the Northwestern station, according to J. A. Peabody, the railroad's engineer of maintenance, and it was decided to profit by the Union station's example.

Tank Lining Material Resists Acids

A NEW acid-resistant material for application in fluid or plastic form has recently been developed and placed upon the market for use as a jointing compound in bell and spigot cast-iron water mains and for lining tanks made of concrete. The new

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material may also be used for pointing joints in acid-proof masonry.

This material, known as Mineralead, is marketed in the form of 10-pound ingots. The material has a melting point of 113 degrees Centigrade, and in use it is only necessary to melt a sufficient number of ingots and apply the melted product, either in the fused or plastic state, to the work. The base of this material is sulfur, which gives it, according to the claim of the manufacturers, almost complete resistance to most acids. Its shrinkage upon cooling is negligible, so that joints or linings made with the material are free from shrinkage cracks and pinholes.

In the tests which have been made with Mineralead thus far, excellent resistance to certain strengths of all acids except hydrofluoric has been indicated. Hydrochloric and phosphoric acids of any strength, most organic acids of any strength, and dilute sulfuric and nitric acids are among the acids which have been successfully handled in this material. Temperature, however, is a limiting factor, as Mineralead is not recommended for temperatures above 100 degrees Centigrade.

A considerable quantity of Mineralead is already in use as a jointing material for water-supply piping. Tests conducted by one of the largest water-supply systems in the country showed a decided superiority for the new material over lead caulking. Strength was considerably higher. No industrial applications have as yet been made with the material as a tank lining, but preliminary tests indicate that a strong and very resistant surface is produced.

In the use of Mineralead for lining concrete tanks, the material is heated to the liquid state and flowed onto the natural concrete surface with a fiber brush. Three coatings suffice to give a thickness of 1/8 to 1/4 inch. This is believed to be sufficient for most purposes. As a lining for concrete, Mineralead is easier to apply than lead and is said to be considerably cheaper. Among the uses which have been suggested for large-scale trial of the material are: electrolytic cells, tanks for phosphoric acid, storage and process tanks for chamber sulfuric acid, and similar applications.—*A. E. B.*

Ideals in Physical Education

IT is now generally recognized that big muscles are not necessarily synonymous with perfect health; in fact, the man who builds himself extraordinary muscular apparatus in order that he may compete successfully in sports may find this excess tissue a hazard rather than an asset after middle age when he is unable to continue his excessive exercise. Physical education should be planned for the vast majority of boys and girls primarily as a means to normal exercise of the body and not in an attempt to build small models of Hercules.

The tremendous crowds attending foot-ball, basket ball, and hockey games have gradually caused these sports to be placed on a pedestal. Young men make them major interests during their educational careers, and find themselves immediately after graduation with no means of livelihood, except professionalism in sports and capitalization of publicity through association with bond houses. Physical education should be planned primarily for health. When it goes beyond this objective, it becomes a menace not only to the individual but to the curriculum of the educational institution.—*M. F.*

New Fumigant for Grain Eliminates Fire Hazard

DEVELOPMENT of a new method of fumigating grain in storage without incurring a fire hazard is an outstanding achievement of government scientists during the past year, Dr. C. L. Marlatt, chief of the Bureau of Entomology of the Department of Agriculture, reveals in his annual report.

The new fumigant is a mixture of solid carbon dioxide, or "dry ice," and ethylene oxide. Tests by commercial handlers of grains have proved the value of the method, which is economical and superior to the more familiar carbon disulfide treatment of grain, due to its non-inflammability.—*Science Service.*

Stopping Cracks in Sheet Metal

EXCESSIVE vibration is the principal cause of cracks in sheet-metal products and components. The continuous bending to and fro of the fibers causes them to crystallize and finally fracture. An effective method of preventing cracks in sheet metal from enlarging or extending is to drill a small hole through the metal at the extreme end of the crack. The hole should be so located that about three fourths of the drill will cut beyond the end of the crack in the sound metal. This method should be followed even when a sheet-metal patch is riveted over the crack, as otherwise the crack will ultimately creep or extend beyond the patched area. Oxy-acetylene welding, however, provides an ideal method of stopping cracks in sheet-metal products, as the metal is annealed by the torch flame which welds the fibers together.—*Machinery.*

Cause of "Jake" Paralysis

THE United States Public Health Service has proof that technical triorthocresyl phosphate was the cause of thousands of cases of paralysis attributed to drinking Jamaica ginger. Ginger itself is completely exonerated. The Jamaica ginger drink responsible for the paralysis was adulterated with the tricresyl phosphate. Ginger snaps, ginger bread, and other ginger delicacies need not be shunned for fear of the disease. The United States Public Health Service has no record of a single case of paralysis caused by ginger put out by a reputable pharmaceutical manufacturer.

The adulterant that caused the paralysis is a relative of carbolic acid. It is widely used in the manufacture of varnishes, shellacs, et cetera. It is cheap and easily obtainable, and was probably used because its physical characteristics make it hard to distinguish from normal ginger constituents. —*A. E. B.*

The Progress of Medicine

IN his address delivered at the opening of the Banting Research Institute of the University of Toronto, named in honor of Frederick Banting, who is credited with the major portion of the discovery of insulin, Lord Moynihan, perhaps one of the most noted among living British surgeons, emphasized the changing point of view of medicine and surgery today. He contrasted the method of Hippocrates, which involved the observation of various symptoms and signs with the Galenic method, which concerned modifications occurring in disease and a study of these modifications by the investigator.

Doctor Moynihan emphasized particularly the importance of physiology in the medicine of today. Many a hospital has physiologists attached now to its staff. The physiologist formerly was concerned entirely with the normal individual. Today he is concerned with detecting as early as possible the first departure from the normal.

Furthermore, surgery which formerly was [illegible] l primarily with removing from [illegible] sed body as soon as possible the portion which was the center of disease is now concerned primarily with restoring that body as nearly as possible to normal state. In other words, surgery instead of being primarily a mutilating branch of medicine has become a reconstructive branch of medicine.—*M. F.*

Electricity to Make "Trolleys" of Steam Lines

"THAT most tantalizing of modern mysteries—the time-table" will be banished with the electrification of steam railroads, according to J. A. Droege, vice president of the New York, New Haven & Hartford Railroad.

Addressing a meeting of the electrical engineers of the American Railway Asso-[illegible] Chicago recently, Mr. Droege saw in electrification the hope of providing passengers the constant service similar to that now received from the street car.

Although a railroad official for more than 25 years, Mr. Droege said he could not read a time-table and make connections. However, with shorter, faster, and more frequent trains which will come with electrification, passengers will be able to wait for the next train without instructions from a time-table.

In discussing the progress of railroad electrification, R. F. Schuchardt, chief electrical engineer of the Commonwealth Edison Company, announced that last year the electric light and power companies supplied 1,000,000,000 kilowatt-hours of electricity for railway operation.

Water and Ice Damage Roads

OUTSTANDING factors causing road damage are water and ice, according to W. I. Watkins of the United States Bureau of Chemistry and Soils, who addressed the eleventh annual meeting of the American Soil Survey Association on the subject, "The Utilization of Soil Surveying in Road Construction."

Mr. Watkins based the conclusions of his paper on 16 years of soil surveying and road construction experience, including four years of co-operative studies with the Bureau of Public Roads. With reference to the importance of soil survey Mr. Watkins said: "A knowledge of soil and soil characteristics enables one to determine in what form and layers the water and ice occur. This knowledge furnishes a basis for determining the character of non-drainable soils and the intelligent designing of drains."

According to Mr. Watkins the detrimental effects and movement of water are greatest during the spring thaw and rains and are most damaging to non-rigid road surfaces. During the winter, ice accumulates in some of the subgrade soils in sufficient amounts to cause them to become supersaturated upon thawing and with the flexing of the road surface the subgrade loses its stability. The road surface breaks if traffic loads are sufficient to exceed the road surface flexibility and subgrade stability.

Mr. Watkins pointed out that in the colder regions of the United States frost and ice accumulation associated with certain types of soil cause a heaving of two inches to a foot in concrete roads. Continuing, he said:

"This produces a decidedly bumpy surface, often causing a concrete road surface to break. Low type road surfaces become soft and impassable during the spring thaw. Such spots are known as 'frost boils.' Frost accumulation is most extensively developed in very fine sandy loams, silt loams, and silty clay loams but seldom occurs in the granular structured, more porous portion of the soil in sufficient amounts to cause damage, unless in a poorly drained position, which causes the soil to become puddled. Puddling destroys structure, increases density and water-holding capacity. This condition is common in roads traversing poorly drained land."—*The United States Daily.*

OUR POINT OF VIEW

(Continued from page 85)

1 cruiser, 7500 tons, six-inch guns, to carry six planes.
11 destroyers, including one destroyer leader.
4 submarines of 1100 tons each.

In addition, the President has recommended that two battleships be modernized, and that 130 airplanes be built for use on the eight-inch gun cruisers, built or building.

These 18 ships are the beginning, and if we continue in accordance with the well-planned program of the Navy Department, by 1936 we will have, built or building, the ships allowed us under the London Conference. In his testimony before the House Committee, Admiral Pratt stated that we will not be able to reach our assigned [illegible]onnage before 1937; this [illegible]mphasizes the condition of naval inferior[illegible], that resulted from our failure to build during the years 1921-29 when w[illegible] lead the world to naval disarmament by e[illegible]ample.

This naval program will be a dire[illegible] boon to our ship-building industry and will indirectly benefit many others. Most of the cost of a ship is in the labor, and practically every dollar expended is spent with in the United States; the disbursement for our new navy will recruit the ranks of the gainfully employed and add t[illegible] national security.

Mr. Stimson Kills Some Rumors

MR. STIMS[illegible] cently paused long enough from reading reports, mainly troublesome, reaching him from all parts of the world, to deny

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officially the following rumors concerning the current foreign policies of the United States:—

First: that any agreement exists between France and the United States to withhold credits to any nation that is contemplating an increase in armaments.

Second: that there was any intention on the part of the United States to co-operate with other powers in the "implementation" of the Kellogg-Briand Pact, or to participate more directly in the affairs of Europe.

Third: that Ambassador Gibson had committed the United States to any revision of the Versailles Treaty.

Fourth: that Great Britain and the United States had come to an agreement concerning the "Freedom of the Seas."

This authoritative statement will assure the American people that their government is not unduly involving itself in the affairs of Europe. We cannot isolate ourselves from European developments, nor could Washington, John Adams, Jefferson, Lincoln, McKinley, Roosevelt, or Wilson. Our people originated in Europe, our past development has been largely affected by European events, and our future will inevitably be profoundly influenced by Europe; but we should avoid entangling ourselves unnecessarily in Europe's local issues. The statement of Mr. Stimson will meet general public approval.

Great Britain and the United States should be able to find a common meeting ground in the matter of the "Freedom of the Seas." If we but realized it, the real interests of both states are identical. Both have depended for protection upon navies rather than armies, and both should uphold the belligerent rights of men-of-war. The vigorous employment of sea-power enabled Britain to support unaided her long war against Napoleon, and sustained Lincoln in his efforts to preserve the Union. When we are neutrals, our trade is vexed by belligerent war vessels, but we should endure this comparatively small inconvenience rather than discard (and try to force Great Britain to discard) the weapon that has preserved both countries in the past and will probably stand them in good stead in the future. It is significant that France and Russia, whose strength abode [illegible] l nations unable t support fleets, have always advocated whittling away the advantages naturally adhering to sea-power; we should beware how we wantonly kick away in the tranquil days of peace the prop that supported us during the fateful days of war.

Mussolini—Stalin —Mustapha Kemal —Venizelos

EUROPE was startled by the recent *open rapprochement* between Soviet Russia and Fascist Italy. Maxim Litvinoff, Soviet representative at the Limitation of Arms Conference, voiced his disgust at the alleged hypocrisy of the conferees and ostentatiously proceeded from Geneva to Milan, where a trade agreement was rapidly concluded between Italy and Russia. The official accounts of these meetings would not disturb nervous Europe, but there are rumors of accompanying secret military agreements that bind Russia and Italy with Germany, Austria, Hungary, Turkey, and Greece into a bloc opposed to France, Jugoslavia, Poland, Czechoslovakia, and Rumania.

In addition to the visit of Litvinoff to Milan, the following significant visits have recently been noted: Premier Venizelos to Mustapha Kemal at Angora; the Hungarian Prime Minister, Bethlen, to Hindenburg at Berlin; and the Turkish Foreign Minister to Mussolini at Rome. This round of visits aroused particular interest and some alarm in France, where the hand of Mussolini is seen pulling the hidden strings. Official England, undisturbed, professes to see Italy acting as mediator between Germany and Russia. England has rarely been nervous when the European continent was fairly evenly divided.

In the new alignment, Russia and Italy pass to the side of the nations that lost the World War, while France still heads the continental nations that won. The French group wishes a strict enforcement of the Versailles Treaty; the opposing group desires to revise the treaty. The instinct of Europe to arrange itself into two nearly equal groups is an old one, and if France succeeds in creating a French bloc on the continent her success will almost automatically result in the creation of an opposition bloc.

One visible result of the re-grouping is an increased boldness in Germany, who demands that her late enemies disarm or permit her to re-arm. Her very able representative at the Disarmament Conference, Count von Bernstorff, former ambassador at Washington, advanced the artless supposition that Germany disarmed in 1919 because the Allies promised to disarm later. Our memories are short but we can still recall that Foch, Haig, Pershing, Beatty, Sims, and other allied leaders gave Hindenburg and Ludendorf more pressing reasons for disarming than the possible future disarmament of Europe. Even Viscount Cecil, devout believer in disarmament, took umbrage at the challenging German tone, and indicated that Great Britain would take her place on the side of the French group if Germany were unduly provocative.

AUTOMOBILES FOR 1931

(*Continued from page* 89)

a gear pump.

The principal change in the De Soto six is manifest in outward appearance. A pronounced lowness, afforded by a newly designed double-drop frame, and certain improvements in body contours coupled with numerous refinements in detail and a longer hood, add a fleet, close-to-the-road appearance. The power output of the engine has been increased by making the cylinders ⅛-inch larger in diameter and by increasing the compression ratio. Longer pistons, a nine-inch single-plate clutch, and a slightly altered carbureter throat design all contribute to the enhanced power, speed, and stamina. Virtually all of the mechanical features which have characterized De Soto production in the past have been retained.

Greater power, acceleration ability, and speed constitute the major changes in the De Soto eight. The engine now develops 75 horsepower, the increase being afforded by an increase of ¼-inch in piston stroke and a slight decrease in gear ratio. The compression ratio is slightly higher; the crankshaft is heavier; and a larger single-plate clutch is used. Mechanical features used in former production are retained. The most marked improvement in appearance is made in the adoption of a slender-profile radiator and a longer hood.

The new Dodge Brothers eight is four inches longer and four inches lower. Displacement of engine has been increased to 240.33 cubic inches; and the engine actually develops 84 horsepower at 3200 revolutions per minute. Road shocks and vibrations are eliminated from the frame and body by a more liberal use of rubber insulation. As to body design and trim, no effort has been spared to make this car a peer in its class.

While no radical changes have been made in the Hudson Great Eight, this car presents a new appearance of smoothness in its swinging streamlines. This new and greater Hudson will be available in 14 body types on two chassis lengths—119 inches and 126 inches—hung low over the wheels on a double-drop frame. Steel replaces wood throughout, even in the roof rails, and improved welding makes the body virtually a single, seamless piece of steel.

The new high compression engine of the Hudson is of the L-head type, the bore being increased to 2⅞ inches and the stroke being 4½ inches. A noteworthy feature of the engine is a full by-pass furnishing a correctly compounded, high-velocity fuel mixture at idling and low speeds. The pistons have cam-ground, flexible skirts, the upper portion being perfectly round while the skirt is ground out to resemble a double cam. Hudson engineers claim that this piston insures better and quicker transfer of heat from the piston head to the skirt, thereby minimizing any tendency to detonation. Another engine detail of interest is a system of cooling the engine oil by causing it to travel around a series of cooling baffles arranged throughout the length of the crankcase reservoir.

Six body types are available on the 113-inch chassis of the Essex Super-Six. Like the Hudson, this car is lower, has cam-ground pistons, and the Hudson-patented oil-cooling system. The motor has added horsepower at all speeds within the usual driving range. The bore has been increased from 2¾ to 2⅞ inches, and improved carburetion now develops 60 horsepower at 3300 revolutions per minute compared to 58 horsepower at a speed of 3400 in last year's motor.

New President and Commander eights by Studebaker offer many improvements such as more powerful engines, longer wheelbase, roomier bodies, as well as many important engineering features; but the free-wheeling mechanism is perhaps the most important. This mechanism was first introduced in America by Studebaker several months ago on President and Commander eights and now becomes available to the modest purse in the Dictator eight.

With the free-wheeling mechanism which is an integral part of the transmission, full use is made of car momentum. The instant the foot is lifted off the accelerator, the engine slows to idling speed. The clutch is employed only to start the car and back up, gears being shifted back and forth between second and high at any speed without the slightest clash. Free wheeling eliminates the reversional strains thrown on tires, rear axle, universal joints, clutch and transmission when the foot is suddenly lifted from the accelerator. Carbon is also reduced because the engine is never forced by car momentum to pump excess oil and gasoline when decelerating. When, however, it is desired to use the engine as a braking medium on hills, a slight touch on the gear lever places the car into conventional second gear and suspends the free wheeling for as long as the driver pleases.

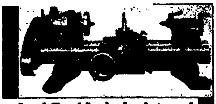
The new Cadillac and La Salle V-8 models in 10 body styles, are more powerful, faster, and more flexible than ever before, and the wheelbase on both is 134 inches. Among other things both cars have springs enclosed in dust-tight metal covers, rear spring shackles of compression type, and bodies mounted on the frame with 14 blocks of thick, live rubber. A new intake muffler eliminates carbureter roar; oil dilution is prevented by a new system of crankcase ventilation; and all bearings are pressure lubricated. Easy starting is provided by double reduction gears. A thermostatic switch automatically increases the charging rate of the generator in winter and decreases it in summer. The cars are equipped with synchro-mesh transmission. Mechanical four-wheel brakes are said to be of exclusive design. Brake shoes are of aluminum alloy and therefore no braking effort is lost by drum expansion since the shoes tend to expand, while working, at a more rapid rate than the drums.

An especially notable development in motor cars is the Cadillac V-16, the first sixteen-cylinder car to be produced in this country and which was announced early in 1930. It has a wheelbase of 148 inches and an engine which develops 165 horsepower. The cylinders are cast eight *en bloc* and set at a 45-degree angle. Besides many other important features which lack of space prohibits detailing, the V-16 has two entirely separate fuel systems consisting of gasoline line, carbureter, and vacuum tank for each block of eight cylinders.

In general the exterior lines of the Cadillac V-12 follow the style motif of the V-8; and the engine is in many ways identical with the V-16, the difference being mainly in that six cylinders are in each block instead of eight. In fact, it is so characteristically Cadillac in design and operation that a great deal of attention will be focused on it.

Employing the first all-aluminum engine, the new Marmon sixteen made its début at the New York Automobile Show. However, there is nothing radical or bizarre in this new car which will be produced in eight body styles. It is built on a wheelbase of 145 inches, is powered by a 16-cylinder engine of 490 cubic inches displacement, and will sell below 5000 dollars.

The engine of the Marmon sixteen was originally designed by Colonel Howard Marmon in 1926, but more than three years were spent in improving it before it was declared ready for production. From a mechanical point of view, this 200-horsepower engine is the most interesting part of the new car. Its light weight gives it the extraordinary ratio of one horsepower to 4.65 pounds engine weight. Carburetion and manifolding have been perfected and simplified by an adaptation of the principle of equi-distant down-draft manifolding originated several years ago by Marmon. There is but one carbureter but this is of the duplex down-draft type. The crankcase is ventilated by the up-draft system. Full



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"Yes" . . . and yet, as Dr. Miles Breuer points out in his article in the February HYGEIA, the cost of a doctor's education is so high that he could buy a good farm that would support a large family on what it costs him to prepare himself to serve his patients. Besides cost of education, office and equipment overhead and repeated post-graduate courses, "the medical profession has more to give the public; and somehow, fro— somewhere, this greater *value-received* must be paid for. As the great mass of physicians are not financially endowed and are not possessed of independent incomes, they are compelled to make their practice pay their expenses." If you want to know what you are paying for when you go to the doctor, you will be eager to read Dr. Breuer's article in . . . the February issue of HYGEIA.

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s simply "air-minded" in an airp
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s Dr. Fasset Edwards.
what Glaucoma is? If
learn of one of the most
diseases that
avoid it. "Emotion in Family Lif

fathers. "Alice in Slumberland" is a health story for the children. These are a few of the articles that appear in the February issue of HYGEIA, the Health Magazine of the American Medical Association. Simply written! Beautifully

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pressure lubrication is provided for every rotating bearing. Other equipment on the engine includes an oil filter, an air cleaner, and a gasoline filter. A three-speed transmission is used, second and third speeds being of the silent type. The Marmon sixteen represents, in many details too numerous to be mentioned, complete coordination of effort between designer and engineer.

Coincident with the presentation of the sixteen, Marmon also announces two new straight eights to round out its line in the more popular priced fields. The first of these is the Marmon 88, of 125 horsepower on two wheelbases, to sell in the 2000-dollar class. The other is the Marmon 70, of 84 horsepower, in the 1000-dollar field.

The new Pierce-Arrow line for 1931 is presented in one custom group by LeBaron and three standard groups. All of these are longer, larger, have many structural improvements, and are the most powerful in Pierce-Arrow history. Of the new major mechanical changes that have been made the most important is the adoption of the Pierce-Arrow designed free-wheeling principle, already regarded by engineers as ranking in importance with the self-starter, four-wheel brakes, and balloon tires.

Oakland's most important change is found in the new synchro-mesh transmission which, combined with the 85 horsepower developed by the improved V-type eight-cylinder engine, provides easy gear shifting and quiet acceleration. Rubber insulation has been used liberally on both this car and the Pontiac six which has been lengthened to a wheelbase of 112 inches. The Pontiac's 60-horsepower engine has been further refined and both the Oakland and Pontiac have new carbureter intake silencers, new electro-plated cylinders, stronger frames, and heavier rear gears.

The trend toward airplane lines noted in some of the new cars is considerably advanced in the Reo-Royale Eight, the first eight cylinder car to come from Reo engineers. The engine for this car, the leader of the new Reo line, is an L-head straight eight delivering 125 horsepower. The Flying Cloud Eight and Six, recently announced, are more powerful than before and are presented in new dress that adds to their appearance of fleetness. The Royale and the Flying Cloud models are equipped with "silent-second" transmissions; bodies have been made roomier; and slanting windshields are equipped with shatter-proof glass. In Reo's full pressure oiling system all tubing inside the engine for conducting lubricating oil has been eliminated. All the oil goes through an oil filter and then to passages drilled entirely in the engine body.

Nash has just announced four new groups of cars ranging in price from 795 dollars to 2025 dollars. Twenty models are in their three new straight-eight series and the six-cylinder group. The horsepower developed by the engine of the eight is 115 compared to 100 in the former Twin-Ignition eight. Perfected, twin-type carburetion accomplished by twin manifolding and duplicate fuel jets is a feature of particular interest. Other distinguishing features of Nash models include: rifle-bored connecting rods for force feed oiling to the piston pins; thermostatic control for water circulation; oil filter and air cleaner; new easy operating clutch; silent transmission; and automatic chassis lubrication.

The Franklin Automobile Company presents two new lines of cars with the well-known Franklin air-cooled engine. Ten body types are in each of these, one of which is known as the De Luxe line, the other as the series 15 Transcontinent. Both series employ the same power plant which is said to have an increased output without increase in size. In the De Luxe models, built on a wheelbase of 132 inches, the tread has been increased to 60 inches. These models also have four-speed transmission while the Transcontinent models have three-speed transmission. All models have shatter-proof glass in windshields, doors, and windows. Many other features have been improved and it is said that the new Franklin is more truly an airplane type—due to its airplane-type motor, lightness, and body design—than ever before.

The 1931 Chevrolet is presented in nine body styles. While the new car reveals no fundamental changes, it has a number of improvements, notable among which are a more durable clutch, smoother and quieter transmission, and new steering gear which makes for easier steering. The hood is longer on the new Chevrolet and the wheelbase is lengthened to 109 inches. The prices are lower than ever before.

In November production was started on the completely new Willys-Overland line. This new line ranges in price from the lowest priced Willys six roadster at 495 dollars through the Willys eight to the highest priced models of the Willys-Knight six at 1195 dollars. Double-drop frames, duo-servo four-wheel brakes, a reduction of the unsprung weight, an increase in the tread, a fuel pump to replace the vacuum tank, optional gear ratios, an entirely new carbureter, and a flame arrester for all carbureters to prevent fires that are caused by back-firing, are some of the more than 100 improvements in the Willys line.

An improvement of major importance is found in the installation of the Float-O o device which assures adequate lubrication under all conditions. Normally the oil is sucked from the oil pan through a
and suction bell which is permanently attached as close to the bottom of the oil as possible; but in the new device, the suction bell and screen are pivoted on an arm and float on top of the oil. As the oil decreases in volume, the Float-O device follows it down. The advantages of this arrangement are: the clean oil from the top of the pan is always that in circulation, and the dirt and sludge that accumulates in the bottom of the pan are always at rest. No matter how stiff the oil, the device eats its way down into the oil until it has reached the bottom of the pan.

This brief review will show that, taken as a whole, the automobile industry during the past year has been exceptionally busy preparing better, safer, more comfortable cars. And it is to the credit of many individual companies that they are giving this year more value than ever before; that, despite numerous improvements in design, mechanical equipment, and riding quality, prices on some cars have already been lowered.

We are indebted to the manufacturers for their kind co-operation in supplying the advance information contained in this article. We regret that, for various reasons, no information was available on those cars not mentioned.

BOOKS SELECTED BY THE EDITORS

PHOTOCELLS AND THEIR APPLICATION—*By Zworykin and Wilson, Research Engineers, Westinghouse Research Labs.*

THIS book fills a big hole and fills it full—there has been no good modern treatise on the photo-electric cell. So this is good news for experimenters, inventors, television workers, and everyone of scientific bent who wants to get an understanding of one of the most promising tools science ever has made available. "It is high time," say the authors in the preface, "that the public in general should be introduced to the modern 'electric eye' and be taught its normal characteristics and its special idiosyncrasies. It has been the distinct aim of this book to do just that thing. The authors have attempted to assemble reliable information from the thousands of articles scattered throughout the world's literature, sift the significant from the inconsequential, and present the residue in the light of their own training and long experience with the subject." These authors, we think, have made good that aim—the book is a treasure; not too technical but neither is it shallow; in short, a practical book for practical people.—$2.65 postpaid —*A. G. I.*

PROFESSOR Einstein's visit to America has brought about an increase of interest in the theory of relativity. To meet this the following list of recommended works, listed in approximate order of abstruseness, has been prepared.

Bertrand Russell—A B C OF RELATIVITY. Considered the best of numerous popular expositions. Postpaid $2.70

Bird—RELATIVITY AND GRAVITATION—*Scientific American prize essays.* . . . . $2.15 postpaid

Eddington—SPACE, TIME AND GRAVITATION. By Einstein's best non-popular interpreter. . . . Postpaid $5.20

Einstein—SPECIAL AND GENERAL THEORY OF RELATIVITY. In English. Requires high school mathematics and a little calculus, and represents the author's effort to lighten his most abstruse discussions. . . . . Postpaid $2.70

Einstein—MEANING OF RELATIVITY. In English. Requires a knowledge of advanced mathematics. Postpaid $2.20

Should additional information concerning references be desired, if you will address the Book Editor, L. S. Treadwell, he will aid you in every possible way.

LIVING AFRICA—*By Professor Bailey Willis, Carnegie Institution*

HERE a noted geologist combines a running, popular account of his wanderings afoot and afield in eastern Africa with a scientific discussion of the great "rift valleys"—vast splits in the earth's crust which he went there to study. Students of geology will be able to follow the account in its scientific aspects and all will find the daily account of travels as fascinating as most travel books are.—$4.20 postpaid—*A. G. I.*

FLIGHTS FROM CHAOS—*By Professor Harlow Shapley, Director, Harvard College Observatory*

DR. SHAPLEY has undertaken the grandest task ever done—arranging in an orderly system of systems—wheels within wheels—everything in the known Universe, from electrons to solar system, from solar system to galactic systems and from galactic systems to the "Metagalaxy," the latter being possibly 100th the diameter of the as-yet unfathomed entire Universe. The most interesting chapters pertain to the vast astronomical entities which only now are being explored and measured. The book assumes an elementary knowledge of astronomy.—$2.65 postpaid—*A. G. I.*

THE MYSTERIOUS UNIVERSE—*By Sir James Jeans*

AGAIN Jeans has given the scientific world a notable book. His work of last year, "The Universe Around Us," a broad picture of modern cosmology, became a scientific best seller. The present work ranks easily as high, though it is different, being more philosophical, more thought-provoking, and centering around the one Great problem which never has been solved—that of the real ultimate nature and meaning of the universe. The chapter headings tell the contents quite fairly. These are: The Dying Sun; The New World of Modern Physics; Matter and Radiation; Relativity and the Ether; and a final chapter entitled. Into Deep Waters, containing Jeans' own attempt to explain the mystery of ultimate reality. Though it is not a large book it covers a remarkably broad territory, touching on everything new in modern physics, astrophysics, and cosmology. Many men of science now are leaning toward a non-materialistic interpretation of the universe and Jeans is one of these. Editors see many new books and perforce must skim or pass by most of them. This one is reserved for a second reading.—$2.40 postpaid—*A. G. I.*

A MANUAL OF CELESTIAL PHOTOGRAPHY—
By E. S. King, Prof. Astronomy, Harvard Observatory

THOROUGHLY practical, and illustrated, this book contains 22 chapters of definite instructions for making astronomical photographs through refracting and reflecting telescopes large and small, both for professional and amateur astronomers. It includes equally practical chapters on the surrounding phases of this work and hobby, such as photographing spectra and meteorites in flight, special developing, and darkroom advice. This new book puts into readily available, usable form the lifetime experience of a noted expert, with all the little wrinkles and kinks which so often make the difference between failure and success freely thrown in. Amateur telescope makers not intending to make astronomical photographs will, nevertheless, learn much about everyday work around an observatory from this book.—$3.20 postpaid—*A. G. I.*

MAN AND THE STARS—*By Harlan T. Stetson, Director, Perkins Observatory*

ONE of our leading astronomers presents the most interesting aspects of astronomy in popular, readily assimilable, easy, comfortable-reading form, choosing the developmental approach; that is, he starts with early astronomy and follows its growth to our times. The second half of the book concerns the new astronomy and a final section discusses questions most frequently asked by laymen—Is there life on other planets? Has life any cosmic significance? Has science displaced religion? Readers are certain not to fall asleep over this book. 216 text pages.—$2.65 postpaid—*A. G. I.*

THIS THING CALLED BROADCASTING—
By Alfred N. Goldsmith and Austin C. Lescarboura

TEN years of radio broadcasting finds the time ripe for an historical survey. But unlike most books to which the word "historical" can be correctly applied, the present one is full of human interest. In ten short years we have passed through a period in the development of communication and

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home entertainment in which events have happened with such bewildering speed that the average person has little concept of the background. This book goes behind the scenes from the earliest days of KDKA down to the present and supplies this background. The authors have broken up the text with trite and often silly and inappropriate sub-heads, but if one will disregard these and read the story of radio as a running narrative, we wager that he will be loath to put the book aside until finished. A chapter near the end of the book titled "Children of Radio" presents some of the developments in other fields that have come about as the result of discoveries in radio experimental work. Not a text book, nor technical in any sense of the word.—$3.70 postpaid—*A. P. P.*

HORTUS—*By L. H. Bailey*

THIS is a concise dictionary of gardening and horticulture for growers, propagators, landscape architects, botanists and students, by a world-wide authority who has been honored by the highest offices attainable in this branch of science. It gives brief descriptions, correct botanical and common names, and notes on culture and propagation for every group of plants in common cultivation in the United States and Canada. The format is particularly well chosen. Headings stand out with sub-matter in proper proportioned size type, bold in the smaller type accentuating the paragraph initial lines. For ready and quick reference we have seen no better dictionary arrangement. 7 x 10. 652 pages.—$10.25 postpaid.

CULTURE AND PROGRESS—*By Wilson D. Wallis, Prof. Anthropology and Sociology, Univ. of Minn.*

"IN this exhaustive study Professor Wallis offers the first comprehensive and critical account of the various phases of culture and presents the first comprehensive survey of the theories of progress. He treats of the theories of progress, considering them in their historical development, and discusses the more important Utopias from the earliest time to the present. The book is a new approach to the essential character of our civilization."—quoted from the publisher's blurb on the jacket, which appears to be accurate. This is not light summer reading; it is intended for people who really do think.—$5.20 postpaid—*A. G. I.*

LITTLE AMERICA—*By Richard E. Byrd, Rear Admiral, U. S. N. Ret'd*

DELIGHTFUL personal day-to-day observations of that most interesting of all polar explorations. Sidelights of human interest concerning men and animals, tales of hardihood and scientific accomplishment, all welded into a most readable story surely no one should miss. Just enough of the technical results is included to inform the layman accurately —the full technical papers will subsequently appear as the real accomplishment to justify all the preparation, expenditure, and personal contribution of the members of the expedition. 422 pages. 74 illustrations.—$5.00 postpaid.

AMERICAN FIGHTERS IN THE FOREIGN LEGION—*By Paul A. Rockwell*

IT is exactly this information that this reviewer has often been curious about. Just who were these men, what inspired them to enlist in the French Army, what did they really do, and what became of them? Because of the various scattered sources of record it has been a vast task to piece together the complete biographies and necessarily these years must have intervened. Here is the story, however, and every page of it is full of interest as we follow these Crusaders of modern times. No more human account of the war has been written than this absorbing record.—$5.20 postpaid.

THE MARKS OF AN EDUCATED MAN—*By Albert Edward Wiggam*

THE widely known author of "The Fruit of the Family Tree" and "The New Decalog of Science" offers us something a little lighter this time; a series of 27 chatty, almost breezy, chapters each of which centers around one of the simple tests by which those of us who are entitled to attach an M.A. or a Ph.D. to the south end of our names (and incidentally the rest of us who can't) may ascertain whether our schooling really was worth all the effort it cost or whether we still are educated fools—provided we are frank with ourselves. For example, if you cultivate the open mind, never laugh at new ideas, get along with people, have acquired the habit of success, know truth from magic, live "a great religious life" and some eleven other things, you are worth saving; otherwise you seem to be a total loss. George F. Babbit liked this book. But there really are a few educated fools, at that. A good gift book.—$3.20 postpaid—*A. G. I.*

ANDRÉE—*By George Palmer Putnam*

TRAGIC adventure in all its starkness or rather the preliminary picture of a Quixotic undertaking, this stresses the remarkably interesting human being, who was a character unto himself, set amid the surroundings which inevitably developed because of the psychological problems which Andrée's nature, actions, and environment forced upon him. It seems almost impossible that an aeronaut and explorer of attainments could have been so almost childlike in some of the reasoning which governed his actions.—$2.65 postpaid.

POPULAR QUESTIONS ANSWERED—*By G. W. Stimpson*

LIKE its companion book, "Nuggets of Knowledge," this scientifically answers a myriad of popular questions such as 'does the upper point of a wheel travel faster than the bottom,' 'what determined the width of standard railroad gage,' 'why a cat always lands on its feet,' 'slipping of car wheels on curves,' 'does odor have weight,' 'does a horse push or pull a wagon,' 'which is heavier, wet or dry sand?', etc., etc., covering a very wide range of subjects. –$2.15 postpaid.

THE CACTUS BOOK—*By Dr. Arthur D. Houghton*

IF we can judge by our florist's windows the cactus hobby is growing, for we see miniature Japanese gardens with the dwarf Japanese trees missing and cacti substituted. These plants require infrequent watering and little care, so those whose plants usually die have an excellent chance of becoming successful indoor cactus gardeners. There are, however, in the present book, minute directions for providing the proper soils, moisture, and special treatment of an immense number of species. These tables occupy 31 pages. Many of the most popular as well as the rarest of cacti are illustrated. This family of plants is strictly limited to the American continent, which is an interesting fact. There are some growers who deal in nothing but cacti and even issue catalogues.—$2.40 postpaid.—*A. A. H.*

FOR YOUR CONSIDERATION

ESPIONAGE—*By H. R. Berndorff*

ORIGINALLY appearing in German to record a very large sale, the author was an officer of the line, later attached to the secret service and lately on the staff of the Crown Prince. Although some of the characters and events here described are the same as have been mentioned in other books, we find no striking repetition, for the sources of information are quite different and the relating of the stories is individual —in fact one does not sense any uninteresting overlapping. The romance of such characters has a gripping interest, especially when exceedingly well told as in this instance.—$2.65 postpaid.

UNDIPLOMATIC MEMORIES—*By William F. Sands*

AS personal advisor to the ill-fated Korean Emperor, these recollections tell the story of an unsuccessful attempt to avert the Russo-Japanese War, the prize for which it was fought being the destruction of the Korean Empire. First of all the "career" diplomats in American history, the accounts of court life, his adventures throughout the country, the descriptions of native customs, and so forth, are portrayed by a trained observer in an extraordinarily varied career and told with urbanity, candor, and unfailing modesty. It makes most interesting reading.—$3.20 postpaid.

HOUDINI'S ESCAPES—*By Walter B. Gibson*

THIS book was prepared from Houdini's private notebooks and memoranda with the assistance of Mrs. Beatrice Houdini and Bernard M. L. Ernst, President of the Parent Assembly of the American Society of Magicians. The latter states that it was Houdini's intention to give to the world many of his tricks and that if he had lived he would have written this book. The writer of this review knew Houdini intimately for over 35 years, "assisted" in some of his box escapes and never received the slightest information as to how one of his tricks was done. Perhaps this was a judgment for refusing to buy Houdini's handcuff trick for 25 dollars in the early days when this sum looked very large to "Harry." Certain of his greatest tricks are not described in this book such as the "Chinese Water Torture Cell." Other methods and escapes now used by professional magicians are also withheld from publication in justice and fairness to conjurers generally. The Society of American Magicians and Houdini's brother all had a hack at censoring the book. We might suppose that with such severe deletions the emasculated form would be worthless, but as a matter of fact enough remains to be of considerable interest. The book has many line drawings which elucidate the text.—$3.20 postpaid.—*A. A. H.*

OUTDOOR SPORTS THE YEAR ROUND

HUNDREDS of ideas for new and popular sports and the making of the necessary equipment, as well as many of the old favorites which have appeared in *Popular Mechanics.* One is amazed at the number and range of practical objects that can be made with the simplest tools and a bit of mechanical handiness. 7 x 10, 352 pages, 650 illustrations. A book that should be the jealous possession of every energetic lad who loves the outdoors and wants to build things.—$2.25 postpaid.

EXPERIMENTAL ELECTRICITY—
By Ralph H. Walters, Inst., Los Angeles College

A MANUAL of experiments in direct- and alternating-current electricity designed especially for use in a terminal course in industrial electricity. It is distinctly a book for the student who cannot avail himself of a college training but who desires a knowledge of enough of the subject to fit himself for minor executive positions in engineering fields. The manual covers 59 experiments which represent a wide variety of topics.—$1.65 postpaid.

AIRCRAFT PROPELLER DESIGN—
By Fred E. Weick, Nat. Advisory Com. for Aeronautics

THIS book presents a discussion of the important theoretical, experimental, and practical developments which have been made in aeronautical propellers, particularly the great advances made during the past few years. Special attention is given to the influence of propulsive efficiency of airplane and engine design. A simple method is given, together with working charts, by means of which propellers can be accurately and quickly selected to fit any airplane for any operating conditions.—$4.20 postpaid.

OIL CONSERVATION AND FUEL OIL SUPPLY
By the National Industrial Conference Board, Inc.

IN this 165-page study of the economic forces and scientific advances that influence the world's use of fuel oil primarily and of other mineral fuels incidentally, there is indicated the possibility of a decline in the supply of fuel oil due to more efficient methods of gasoline production. To the United States, consumer of 60 percent of the world's production of fuel oil, such a decline would be catastrophic. Accordingly, in this volume are analyzed in detail the problems that would arise in such an event. The relationship of energy to civilization, industry, and trade; the competition between modern sources of energy; world supply and consumption of fuels; production and consumption of fuel oil in the United States are treated exhaustively; and finally, in connection with a discussion of the effects of a decline in fuel oil supply, it is set forth that present conditions are favorable for undertaking an oil conservation program. This work has been carefully built, stone on stone, so that the resulting edifice is a book of utmost importance alike to producers and consumers of fuel and power.—$2.65 postpaid—*F. D. McH.*

A ROVING COMMISSION—*By Winston S. Churchill*

FEW who measure this picturesque character by his effective occupation of positions of highest honor and responsibility in the British government realize that his early career rivals in interest and wealth of experience the most fictitious tale of any soldier of fortune. Educated at Sandhurst, drawn by a spirit of adventure into the Spanish pacification of Cuba, then several years of Indian frontier service, in Egypt against the Dervish, with Buller in the Boer War when he was captured, escaped, and became world renowned; finally in the South African Light Horse he saw the general pacification established. One cannot afford to miss this splendid autobiography.—$3.65 postpaid.

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COMMERCIAL PROPERTY NEWS

Conducted by **SYLVESTER J. LIDDY**

Member of the New York Bar

Radio Tube Patent Held Valid

THE validity of the Irving Langmuir patent for vacuum radio tubes, owned by the General Electric Company, was upheld by the Circuit Court of Appeals for the Third Circuit in an opinion handed down, reversing a contrary decision of the District Court for the District of Delawi

The suit, according to the opinion, was instituted by the General Electric Company charging the DeForest Radio Company with infringement of the Langmuir patent in the manufacture of its tubes. The patent at issue, 1558436, was granted to Mr. Langmuir in October, 1925.

The Circuit Court of Appeals found that the DeForest company was manufacturing a tube within the description of the Langmuir patent. The similarity of the patents was pointed out and the chief point of difference declared to be in the fact that the DeForest patent, coupled with what is termed the "Fleming valve," operated in a gaseous tube while the Langmuir tube was non-gaseous and "of a very high vacuum."

The DeForest company had previously manufactured gaseous tubes but abandoned it for the vacuum type, upon which action the suit was brought by the General Electric Company.

For the final analysis, the court said, usefulness is the test. The tube in question it described as an agency which "because of its stability, reproductibility, and power has made possible radio broadcasting, modern radio reception, and long distance telephony."

"The fact that a non-gaseous vacuum tube makes possible the present improved practice shows such practice did not exist before the Langmuir tube and no other device or devices, all important as they may have been in their spheres, did either singly or collectively produce the present practice."

Without disregarding the all important part DeForest's audion and Fleming's valve play in the utilization of them in the Langmuir tube, the court said it remained for Mr. Langmuir "to so couple and coordinate the two by means of eliminating gas and using vacuum as to produce the tube here involved."

It was pointed out that in the gaseous tubes there was vast difference in behavior while, on the other hand, "the current in the Langmuir tube is practicable, steady, reproducible at any particular voltage." As to replacement the court pointed to the advantage of the Langmuir tube in that another of the same type can be bought and placed in the same socket. This was not true of the DeForest audion.

Prior to the Langmuir tube, it was noted, the whole trend of the art was against the use of a vacuum and even after he had shown its use, it was deemed impracticable.

"For the DeForest company now to contend the use of these extremely high vacua by Langmuir was simply the natural and to be expected growth of the art is to credit the ordinary art with a scientific capacity, which a master of the art like DeForest did not himself possess," the opinion concludes.

MR. LIDDY will be pleased to answer the inquiries of our readers who may desire information relative to the various subjects reported in his department.
—The Editor.

"Advance, inventive and non-inventive, was being made in the art, but the efforts were in other directions. We would not detract from the great advance of DeForest as exemplified by his audion and by Fleming with his valve, but great as these steps were—both separately and collectively—and we regard them as the foremost in the advance of the art in the sphere here involved—the gaseous tubes still continued to be used and the art generally regarded gas as incident, if not, indeed, indispensable to their use," the court declared.

The opinion of the court was written by Judge Joseph Buffington, with whom Judge J. Warren Davis concurred. A lengthy dissenting opinion, covering over 20 printed pages, however, was returned by Judge Victor B. Woolley.

Judge Woolley, in his dissenting opinion, declared that the Langmuir patent was invalid because of lack of invention and prior use. The majority opinion, he stated, was based "on what I am constrained to believe is an erroneous theory or finding that all discharge tubes before Langmuir were gaseous and that Langmuir's invention is a non-gaseous tube." He cited a number of prior publications and patents to show that Langmuir was not the first person to make and invent a non-gaseous tube. The first and original inventor, he declared, was Arnold.

Anne Nichols' Plagiarism Suit Lost

THE decision by Federal Judge Henry W. Goddard in dismissing the 3,000,000 dollar suit by Anne Nichols against Carl Laemmle, Harry Pollard and the Universal Pictures Corporation for alleged plagiarism of Miss Nichols' play, "Abie's Irish Rose," in the motion picture production, "The Cohens and the Kellys," was upheld unanimously recently by the United States Circuit Court of Appeals.

The opinion, written by Judge Learned Hand, held that the Federal copyright laws had not been infringed by the mere fact that there were similar characters in each of the productions. He held that it was scarcely credible that Miss Nichols "should not have been aware of the stock figures, the low comedy Jew and Irishman." Most of the ideas in both the play and the cinema had been developed previously so many times it was ruled that they were "as little capable of monopoly as Einstein's doctrine of relativity."

Judge Hand concluded his opinion, which was concurred in by Judges Augustus N. Hand and Thomas W. Swan, by criticizing the extended testimony given at the trial by expert witnesses. He intimated that in proceedings before a judge sitting alone it would seem advisable to exclude such evidence on the ground that it serves "only to befog the issues."

Miss Nichols' play ran for five years after its opening in 1922. Later she sold the motion picture rights to the Famous Players-Lasky Corporation. The decision by Judge Goddard was handed down in May of 1929.

Lack of Distinction Prevents Registration

ASSISTANT Commissioner Moore held that Walter L. Fry, of New York, N. Y., is not entitled to register, under the Act of 1905, as a trademark for seat covers, a mark consisting of the surname "Fry" printed in black, the name being written with a capital "F" followed by a capital "R" and a small "y", the top of the "F" extending over the other two letters.

The ground of the decision is that the name is not written in a distinctive manner and therefore its registration is forbidden by the statute.

Plant Patent Aid Provided

AN Executive Order (No. 5464) recently signed by President Hoover, directs the Secretary of Agriculture to furnish to the Commissioner of Patents certain assistance in carrying into effect the Act (Public No. 245) providing for plant patents. (See page 490, June 1930 issue of SCIENTIFIC AMERICAN.—*Editor.*)

The Secretary of Agriculture is directed to furnish such available information of the Department of Agriculture, to conduct such research upon special problems, or to detail to the Commissioner of Patents such officers or employes of the Department, as the Commissioner may request for the purpose of carrying the act into effect.

Trade Commission Rule Amendments

THE Federal Trade Commission has amended its rules of practice relating to the filing of answers to the commission's complaints so as to complete or clarify the text of the paragraph covering the waiving by respondent of hearing on the charges set forth in the complaint.

The new wording specifies that when the respondent waives such hearing, the commission shall be authorized, "without a trial, without evidence, and without findings as to the facts or other intervening procedure, to make, enter, issue, and serve upon respondent an order to cease and desist from the method or methods of competition charged in the complaint."

Full text of the second paragraph of the commission's rule as to answers (Rule III, Answers), as amended, is as follows:

(2) In case respondent desires to waive hearing on the charges set forth in the complaint and not to contest the proceeding, the answer may consist of a statement that respondent refrains from contesting the proceeding or that respondent consents that the commission may make, enter, and serve upon respondent an order to cease and desist from the violations of the law alleged in the complaint, or that respondent admits all the allegations of the complaint to be true. Any such answer shall be deemed to be an admission of all the allegations of the complaint, to waive a hearing thereon, and to authorize the commission, without a trial, without evidence, and without findings as to the facts or other intervening procedure, to make, enter, issue, and serve upon respondent an order to cease and desist from the method or methods of competition charged in the complaint.

English Adopt Slot Machines

VENDING machines through which medicines and other drug store articles are sold are almost absent from the American market, although there are many in England, it was stated recently by J. A. G. Pennington, of the Specialties Division, Department of Commerce. These machines are not present to any great extent in any of the continental European countries, he added.

The recent importation of such a vending machine by a pharmacist at Johannesburg, South Africa, aroused considerable interest, according to a report from Trade Commissioner Edward B. Lawson, Johannesburg.

This machine is a typical British "shilling-in-the-slot" device and has 22 drawers, each labelled. Due to the range of articles which can be sold through automatic vending machines, if the initial introduction is successful, other drug stores are expected to follow the lead.

Hair Tonic Advertising Copy Toned Down

A HAIR tonic sold in interstate commerce will no longer be advertised by the corporation producing it as a sure treatment for cultivating growth of the hair.

Signing a stipulation with the Federal Trade Commission, the company specifically agreed to cease and desist from advertising that its product is an effectual, or guaranteed, or a sure treatment for cultivation of hair growth; or that a fresh growth of hair is assured by use of the tonic; or that the company's method is the only way to grow hair; or that application of the tonic will produce a growth of hair.

Among representations in advertising to be discontinued by the firm, are the following:

"No need to be bald."

"Bald men grow hair quick."

"The only hair treatment yet devised which goes direct to the source of baldness."

"What I accomplished on my own head and on others I can do for you."

"I will prove to you free that I can grow hair quick."

"We know it will help you to re-grow your hair."

The company also agreed to stop the use of special or free offers unless they are made in good faith, or of other representations having the capacity to mislead buyers into the belief that the product described will produce the results mentioned, when such is not the fact.

Patent Applications Increase

RECEIPTS of applications for patents, including many for radio and talking picture equipment and refrigerators, during the 10 months ending Oct. 31, show that 1930 was the biggest year in the history of the Patent Office, Commissioner Thomas E. Robertson stated recently.

Applications for radio patents, the Chief Clerk, J. A. Crearley, said, have become so numerous that one entire division and portions of two other divisions have been assigned to this work. Requests for patents on sound picture equipment and refrigerators also have increased greatly in the last few years, he said.

Applications received during the 10-month period, Mr. Robertson said, showed an increase of 500 over the number for the corresponding period of last year. The total for the previous "peak" year, 1929, was 75,402, he explained, while from January through October this year the applications have reached 75,868.

An increase of over 1300 occurred in applications for trademarks during the first 10 months of this year, Mr. Robertson added, but there was a slight falling off in applications for "design" patents.

At the present time approximately 112,838 applications are pending before the Patent Office awaiting action. During the past six weeks this number of pending applications was reduced by over 5000. This was accomplished by the addition of a number of examiners authorized by the last session of Congress, and it is estimated that the total number of pending applications is now being decreased at the rate of 1000 a week. Nearly two years, at this rate, will be required before the Patent Office will be able to reduce the accumulation so that it can act upon every application within 60 days from the date it is filed.

Ice Cream Quality Protected

"BOOTLEGGING" ice cream is to be stopped by the Pennsylvania Department of Agriculture, according to a statement issued by the Director, Dr. James W. Kellogg, of the Bureau of Foods and Chemistry.

The substitution of an inferior product for a well-known recognized brand of ice cream is unlawful, the statement says, and a check is being made of the advertising and selling of ice cream throughout the Commonwealth.

The statement follows in full text:

The practice of "bootlegging" ice cream, which has come to the attention of the Department recently, consists of an unscrupulous manufacturer taking advantage of another manufacturer's contract for the sale of a well-known recognized brand of cream by submitting the former's own brand to be sold under the advertising devices and contracts of the other manufacturer.

In some cases these manufacturers entering into such a competition buy so-called ice cream mixes from wholesalers and without much equipment can arrange to complete the product by addition of flavors, fruit, etc., at a much lower cost than the person can afford to manufacture and advertise when operating a well-equipped ice cream factory.

Such a substitution of ice cream is in direct violation of the Ice Cream Law, section 3, which makes it unlawful for any person to sell any ice cream from any container which is falsely labeled or branded or to misrepresent in any way the place of manufacture of ice cream or the name of the manufacturer.

While the practice has not gained a very strong foothold in Pennsylvania, ice cream dealers are warned against the sale or substitution of so-called "bootleg" ice cream for the product which they may be selling under contract with other ice cream manufacturers.

A checkup is being made by agents of the bureau regarding correctness of advertising and selling ice cream throughout the Commonwealth and any persons found engaging in dispensing "bootleg" ice cream will be held responsible under the provisions of the Ice Cream Law.

Soap Maker Will Stop Patent Misrepresentation

A CORPORATION soap manufacturer signed a stipulation with the Federal Trade Commission agreeing to cease the use, on labels attached to the containers in which its products are packed and sold, of words indicating that it has a patented process, when such is not the fact.

(Names of individuals or firms signing stipulation agreements are not mentioned in the commission's press releases or publications, but the facts in each proceeding are presented to show methods of competition condemned by the commission as unfair, for the guidance of industry and protection of the public.)

Conflicting Shoe Mark Refused

IN a recent decision, Assistant Commissioner Moore held that Murray M. Rosenberg Inc., of New York, New York, is not entitled to register as trademarks for shoes, marks, the dominant feature of which consists of the words "Miles Shoes," in view of the prior registration by the W. H. Miles Shoe Company, Inc., of marks, the dominant feature of which is the word "Miles."

In his decision the Assistant Commissioner stated that the dominant feature of the registered marks is the word "Miles," the words "Blue Ribbon Brand" and "Extra Quality" appearing therewith being phrases relating to the grade of the shoes and the words "Greatest Values in the City" being merely an advertising slogan.

He then said:

"It is observed that the cited registrations are owned by the W. H. Miles Shoe Company, Inc. and it is believed that the average member of the purchasing public would believe that the 'Miles Shoes' originated with or are owned by the Miles Shoe Co."

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SCIENTIFIC AMERICAN PUBLISHING COMPANY
Formerly Munn & Co., Inc., 24-26 West 40th Street, New York

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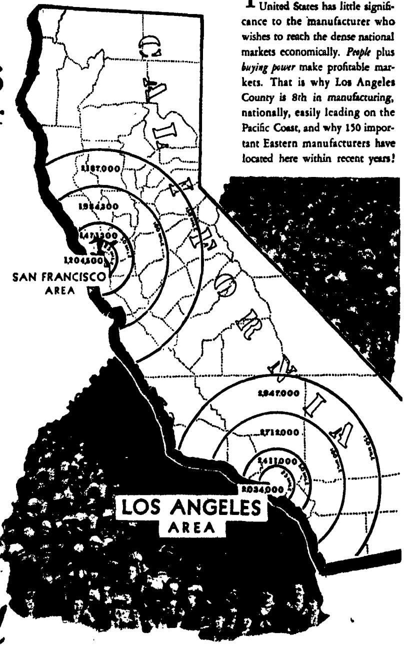

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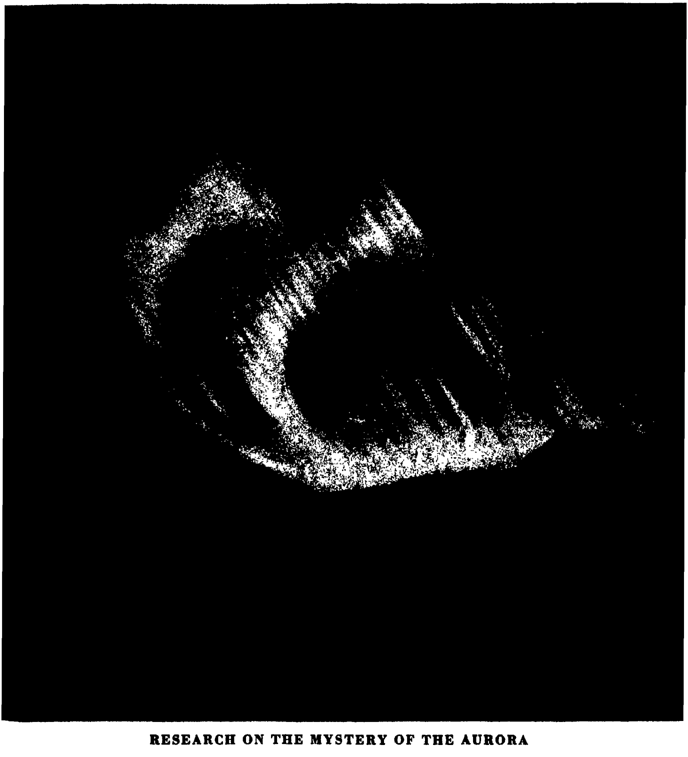

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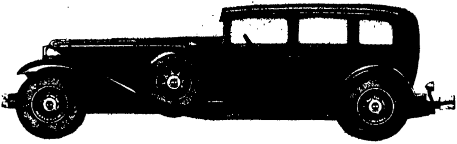

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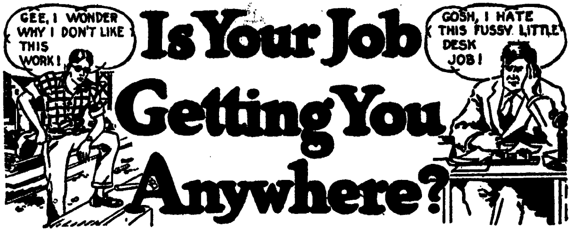
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SCIENTIFIC AMERICAN

Owned and published by Scientific American Publishing Company; Orson D. Munn, President; Louis S. Treadwell, Vice-President; John P. Davis, Treasurer; I. Sheldon Tilney, Secretary; all at 24 West 40th Street, New York, N. Y.

EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

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THIS MONTH'S COVER

Our cover artist, Howard V. Brown, has this month made a composite painting. The aurora shown is similar to that in the painting by Harold Moltke which was submitted by Dr. D. la Cour, an outstanding Danish meteorologist, at the recent meeting of the International Geodetic and Geophysical Union in Stockholm, Sweden. The instruments are those shown in illustrations which accompany the article entitled "The Aurora—Elusive Mystery of Science," and the site is a snow-streaked ridge in Alaska where American men of science are observing the aurora at the present time.

Amateur Telescope Making

ALBERT G. INGALLS, *Editor*

EVERY month in the back pages of this magazine you will see from three to five telescopes that have been made from the explicit instructions contained in this book. What others have done you can do. Send for a copy of this book on approval and see for yourself. $3.00 postpaid.

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The Use of the Microscope

By JOHN BELLING
Cytologist, Carnegie Institution

SINCE the appearance of the article in S. A. some months ago, on this subject, much interest has been aroused in this important method of research. This is a straightforward, concise treatment indicated by the experience of an expert acquired after a long career. It is practical and accessible. $4.20 postpaid.

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ACROSS THE EDITOR'S DESK

OUR editorial policy, here on the Scientific American, has frequently been criticized, both favorably and adversely, for its conservatism. We have always held, however, that conservatism is a necessity if a scientific magazine is to publish material that can be relied upon as being authentic as to source and accurate as to detail. Even at that, with this policy constantly in mind, there occasionally comes a time when too strict adherence to conservatism must be avoided in the light of sound theory. The "moon rocket" is a case in point. Pooh-poohed by many as impossible and wildly imaginative, the recent donation by the late Daniel Guggenheim of a large sum of money for research on rocket problems has put a new face on the entire subject. The author of the article on rockets that appears in this issue has presented the facts and has looked into the future with eyes that take these facts into consideration.

●

If, due to uncontrollable conditions, local power plants sometimes fail to supply the amount of power needed by the community, what can be done to tide them over? This is the question that confronted a power company of New England, where plants are largely hydro-electric and so are greatly affected by droughts. The answer was found in a portable power plant that could be sent to any point along the coast and used until the unusual conditions abated. The details of this floating plant will be found in this issue.

●

In this issue, also, Raymond B. Fosdick bares some pertinent truths relative to the economic status of the United States—facts that you and I have vaguely considered in our moments of communion with ourselves but which not many of us have been honest enough to admit openly. In view of the depression's disastrous effect on the world, it is well for us to take stock of ourselves and try to grasp the meaning of the interdependence of nations as brought out in Mr. Fosdick's able article.

●

Ladders for fish so that they can get up-stream to spawn despite man's encroachment in the form of dams; a new method for determining the hardiness of wheat without the necessity of waiting for winter weather to tell the story; how life-size and miniature groups of animals are prepared for museums; something of the glory that was Peru's—these and many other subjects form the body of this issue, backed up as usual by many shorter items of wide general interest in the Scientific American Digest.

●

Speaking of conservatism, as we were in the first paragraph above, another example comes to the fore as we glance through the tentative schedule for the April issue. Most of the daily papers, and many magazines that should have known better, carried a story about a "meteorite" that fell through the hood of an automobile. The story was submitted to us, but we turned it down because of its lack of authenticity. Now we can present the facts, even though the story comes to our readers a little later than other publications printed it. News may be news only if new, but facts are necessary to science and it often takes time to assemble them so that the resulting article is accurate and not just the snap judgement of some biased or uninformed reporter.

●

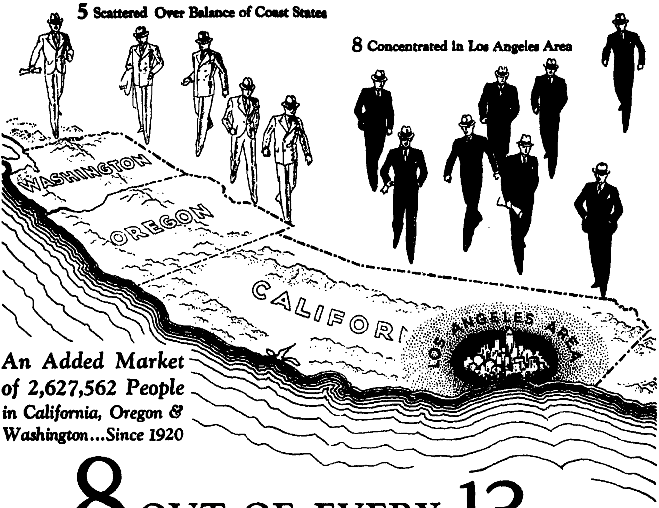
How often all of us have wondered, as our train threaded its way through a maze of tracks in a great railroad terminal, how it is humanly possible to prevent numerous smash-ups. The signaling and control system behind the efficiency that guides our train unerringly into its proper track is nothing short of marvelous; and the story of it, to be published in our next issue, is a story of almost incomparable human ingenuity. Railroad men who have already seen this article have congratulated us upon it for they say it clears up many details of railroading which, even to them, were previously mystifying.

●

In the Naval Research Laboratories in Washington, significant things have been done with the gamma rays of radium. Having a shorter wavelength than X rays, these gamma rays have been used to study the internal structure of metals and materials. The process, however, is much simpler than the procedure with X rays. No delicate tubes, elaborate wiring, and so forth are necessary, for a tiny capsule of radium salts, placed before the material to be studied, does the trick. These researches will be discussed in a coming article.

●

Other features for April will include information on such subjects as radio and the police, an outstanding railroad bridge, the industrial uses of vacuum tubes, a new method of making superior concrete piles, and many others. Our cover illustration will present an unusual angle of an engineering subject.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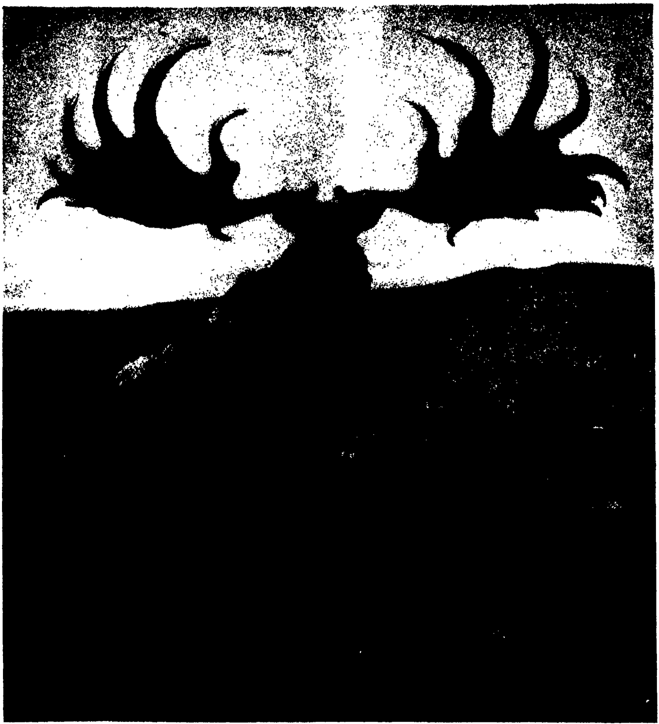
EINSTEIN GOES SAILING

LIKE other normal human beings Einstein plays part of the time, and sailing on the lakes just outside of Berlin is his favorite outdoor sport. As soon as a man becomes great, people begin to surround him with an accretion of imaginary tradition, and find it difficult to think of him as pursuing the pastimes of ordinary folk. For example, this photograph of Einstein lay a few days on the editorial desk and several persons remarked that the professor's facial expression was "most profound" and that he no doubt was "deep in thought about some new recondite theory." The chances are, however, that when Einstein goes sailing he goes sailing, and leaves ashore the whole Einstein theory. Probably his profoundest, most abstruse thought when this snapshot was taken had to do with the theory of the relative probability of dinnertime. It is doubtful whether the great physicist-mathematician knows or cares a rap in practice, whether the metacentric height of his craft is subtended by the square root of the center of effort of the mainsail or not—so long as she is properly trimmed and points up as close to the breeze as she ought. In this picture, physicist Einstein finds one thumb enough to hold the helm, and the chances therefore are that the wind has petered out.

Several months ago the editor stated that the Einstein theory was accepted by the majority of scientific men qualified to judge of its validity, and this conservative assertion was challenged by certain readers who do not accept relativity. In the latest edition of the Encyclopaedia Britannica Sir James Jeans, writing on "Relativity," is less conservative; he says acceptance of the relativity theory is "universal and complete."



Copyright Field Museum of Natural History

EXTINCT BECAUSE OF TOO MUCH EVOLUTION

THE giant Irish deer often attained an antler spread of 12 feet. It became extinct in the 14th Century, doubtless due to over-evolution of the antlers. Its body was about the size of that of a moose and the animal was the largest of the deer family. A skeleton is on exhibition in the Field Museum of Natural History in Chicago, while the painting, done by the scientific artist Charles R. Knight and presented by Ernest R. Graham, is on the walls. Mr. Knight is not merely an artist but a student of paleontology, and before he undertakes paintings of extinct animals he makes a thorough study of the scientific background. He has promised to tell in an article in the SCIENTIFIC AMERICAN how he approaches and executes a typical painting of this sort, in order that no errors in science will enter.

Professor Krogness in the new auroral observatory near Tromsoe, Norway. Note telephone headset; also three auroral cameras, the chronometer, and the large spectrograph

THE AURORA—ELUSIVE MYSTERY OF SCIENCE

By N. H. HECK

Chief, Division of Terrestrial Magnetism and Seismology,
United States Coast and Geodetic Survey

EVERYONE who has seen the aurora at once asks for an explanation. Not many years ago any that might have been given would have little significance today. The developments of modern physics have made it possible not only to adopt a definite type of explanation, but progress has been made in outlining theories which explain the more important facts.

With this understanding it is my purpose to outline the principal known facts of the aurora and to give the present status of the efforts to explain it by theories acceptable to science. This discussion is peculiarly appropriate at this time since recently there has begun at Fairbanks, Alaska, the first comprehensive program of auroral observations under good conditions that has been made on the North American continent, except observations carried on from time to time by Arctic explorers. The program, which is to continue for five years, is being carried on at the Alaska Agricultural College and School of Mines with the financial support of the Rockefeller Foundation and with the assistance of the Carnegie Institution of Washington and the United States Coast and Geodetic Survey. The latter provides information regarding the earth's magnetism from its magnetic observatory at Sitka, Alaska, which though nearly 1000 miles to the south, records magnetic conditions not too greatly different from those at Fairbanks. Auroral observations have been carried on at Sitka for a number of years, but under very unfavorable conditions on account of the generally rainy and cloudy weather of southeastern Alaska. Fairbanks in sharp contrast has ideal weather conditions except for extreme cold, and it also has the great advantage of being within the belt of maximum auroral frequency.

SCIENTIFIC auroral investigations started in Norway where the relatively large number of people living in the region of maximum frequency provides better conditions for the study than in most other parts of the belt. The more favorable conditions do not, however, take away the credit of initiative of the Norwegian investigators, who have been willing to face the difficult problem and endeavor to find a solution. Many have worked in this field but especial credit must be given to four men who have done outstanding work in their own country and who have stimulated others there and elsewhere. These are Birkeland, Störmer, Vegard, and Krogness. The three latter are living and constantly adding to the store of knowledge in regard to the aurora. The importance of the work in Norway has been recognized by the Rockefeller Foundation which has helped to finance a magnificent new auroral observatory.

The work has steadily become international. As an example, the International Geodetic and Geophysical Union, through a committee of which Carl Störmer is chairman and the writer is member for the United States, has published an auroral atlas and instructions for auroral observations. One of its features is a classification of auroral forms, which is necessary to an understanding of the subject. The classification is very complete and only the more important forms will be listed.

Remembering that the different forms are often poorly defined and that different forms may occur at the same time, there are two classes of forms: those without ray structure and those with ray structure. Forms without ray structure include: Homogeneous quiet arcs (Figure 1); homogeneous bands (Figure 2); pulsating arcs, sometimes entirely disappearing and then reappearing in the same place; diffuse luminous surfaces, widely spread but without distinct boundaries. Forms with ray structure include: arcs with ray structure (Figure 3); bands with ray structure (Figure 4); draperies (Figure 5); rays (Figure 6); corona (Figure 7). The figures are reproduced from Störmer's new auroral catalog. This rather formidable list is in itself ample evidence of the complex phenomenon which we are trying to explain.

In the earlier days when the development of theory was impossible because of inadequate knowledge of physics, excellent work was done by the statistical method. This brought out very clearly the distribution of the aurora in the arctic region and established a very important fact. This is that the lines of equal intensity are nearly circular in form, with the center of the circles near

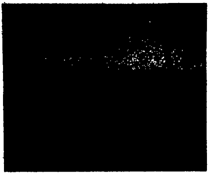


Figure 1

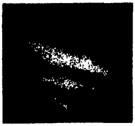


Figure 2

Figure 3

Figure 4

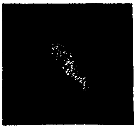


Figure 5

Figure 6

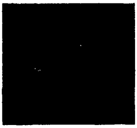


Figure 7

Störmer's seven forms of auroras, reproduced from his new atlas

Smith Sound in Greenland. Studies of the earth's magnetism have given a significance to this place, since if we assumed that the earth's magnetism is due to a magnet near its center, the axis of this magnet, prolonged in the general direction of the north pole, would reach the surface at Smith Sound. For convenience, we will call this the north auroral pole. The belt of maximum auroral frequency is found to be 23 degrees from the auroral pole and this fact has proved to be a very serious stumbling block in the way of those who are trying to provide satisfactory theories. The frequency falls off rapidly both to the north and south of the maximum auroral belt. The facts are probably similar for the antarctic region, but for obvious reasons the observations there are incomplete and it is not possible to draw the lines of equal auroral frequency. (See map, page 155)

IN the case of most physical phenomena, methods of observation are obvious but the aurora is far above the earth and beyond our reach and it is therefore not possible to make direct observations in the region where it occurs. On the other hand, of all the phenomena which investigation has shown to be related to the aurora, it alone can be directly perceived by our senses, and this is a very great advantage. However, the unaided eye must be supplemented by instrumental means and the first thought is naturally the use of photographic methods. This is not as easy, even for quiet forms, as it might seem, since the aurora, while bright against the darkness of the night, is relatively feeble, and it is difficult to take satisfactory photographs. There also must be a definite purpose in taking the photographs in order that useful facts may be brought forth. Störmer has done much to solve these problems and it is no longer difficult to take satisfactory photographs. He also has found it possible to measure the height of the aurora above the earth by combined photographic and astronomic methods. The method requires that there be two observers, each with a camera, located at two stations, the distance between which is known (as, for example, ten miles) with direct communication by telephone or radio so that the cameras may be exposed at the same instant. A selected auroral form is photographed at the same time at each station, this being made possible by directing the cameras at one or more selected stars. The aurora is photographed against the stars and the displacement with regard to the stars at the two stations gives the necessary data for computing the height of the aurora.

A vast number of these determinations have been made, but only a few characteristic results obtained in Norway need be mentioned. In the maximum auroral belt the bottoms of the various forms range from 90 to 100 kilometers (56 to 62 miles) above the earth, with heights for the upper portions from 300 to 500 kilometers (185 to 300 miles). In one case when observing in the vicinity of Oslo, Störmer obtained a height of 1000 kilometers or 620 miles. The lowest he has obtained is 80 kilometers or 50 miles and, in spite of the fact that persons have reported seeing the aurora reach the earth, there is no instrumental evidence to support this.

If photography can be successfully employed for the quiet forms, the obvious thought is—why not motion pictures for the moving forms? While the idea has merit, experience has shown that true motion pictures are impossible because the exposure must be at least two seconds. Pictures at this interval would be valuable though scarcely able to follow the fastest moving forms. There are many problems to be solved before the use of this method will be entirely satisfactory.

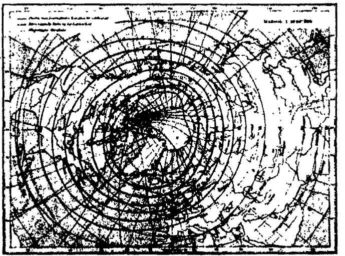
Another method of direct observation is the use of the spectroscope and this has been done by Vegard. Using a special type of spectroscope he found a definite line in the green portion of the spectrum. Careful study of its characteristics did not result in identification with any other known line of the spectrum. The source of the line was a real puzzle. Vegard, after experiments in bombarding solid nitrogen by cathode rays in the laboratory, was able to obtain this line and he therefore advanced the idea of the existence of crystals of solid nitrogen in the upper atmosphere. Later, however, McLennan obtained the line from a mixture of oxygen and helium. (See McLennan, "Mystery of the Green Line," SCIENTIFIC AMERICAN, January 1929.—*Ed.*) It is significant that the green line has been found to be present in the night sky everywhere.

IN addition to direct observation of the aurora by the means that have been described, another line of attack has been the study of correlations of the aurora with other phenomena. Since the auroral belt is in the general region of the north magnetic pole it is natural to see whether a relation between the earth's magnetism and the aurora can be found. While the occurrence of auroras in the maximum auroral belt does not always correspond to pronounced magnetic disturbance, there are no known cases where an aurora seen far to the south has *not* corresponded to a magnetic storm and usually to a severe one.

Many theories hold that some sort of ray reaching the upper atmosphere spirals around the lines of force of the earth's magnetic field. The line of force passing through a given point has a definite position with regard to the earth. If at a height of several hundred kilometers above the earth the direction of a line of force is unchanged from that which it is observed to be at the surface we should expect to find that, in the case of those forms of aurora with rays extending outward from the center, the center would lie in the direction given by the observation of the earth's magnetic field at the surface of the earth. It is found by observation that such centers almost correspond but may vary by as much as one degree.

Minor fluctuations in the aurora have also been associated with changes in magnetism. We have sufficient evidence that these two phenomena are closely related and, therefore, work in developing theories in the one field may be not only helpful but essential in the other.

We all recognize atmospheric electricity in the form of lightning, but this, though often severe, is a local, temporary phenomenon. In all parts of the earth, as evidenced by observations, there is, however, a continuous discharge from air to earth, minute in amount but measurable. It would be reasonable to expect a relation between this and the aurora, but careful observations in Norway at the time of a strong auroral display showed none. Earth-currents in the upper layers of the earth's crust, also minute in amount but measurable, are found in every part of the earth. At times these become very great and are able to interfere with telegraph and similar transmission. The important difference between these and atmospheric electricity is that earth-current disturbances occur in connection with strong magnetic storms and with aurora reaching far to the south. The relation between the great auroral displays and increased earth-currents may be considered to be established.



From Geographische Verbreitung des Nordlichtes, H. Fritz, Justus Perthes, Gotha

Auroras in the arctic. The heavy lines are "*isochasms*," lines of equal auroral frequency. They center around Smith Sound at the northwestern corner of Greenland, which is therefore the north auroral pole. The innermost heavy line marks the belt of maximum auroral frequency. The dotted *lines are the magnetic meridians; they converge at the* north magnetic pole in Boothia Peninsula, northern Canada

IT has been stated that great auroras are associated with disturbances in communication by wire or cable. Since the aurora exists in the region of the atmosphere through which radio waves must pass, its relation to radio reception is one of very great importance. Observations have been made at a number of places and, while conditions are changed during periods of disturbance, it is by no means established that communication is seriously interfered with. It is only recently that a theory has been developed and observations have been made which seem to explain this situation. In the early days of radio it was difficult to understand how radio waves passed around the earth, since there was no adequate explanation for their taking curved paths. The conception of the so-called Kennelly-Heaviside layer, an ionized layer about 100 miles above the earth, has solved the problem and observations have made it possible to determine the height of the layer. This is done by recording the difference in time between the wave which traverses a direct path from transmitting to receiving station, generally called the ground wave, and the wave reflected from the layer. This layer should not be considered as a fixed and definite, sharply reflecting surface, but rather a zone in which the radio waves are reflected or refracted. This layer does not remain at the same height all of the time but goes through daily fluctuations. In fact, at times echoes indicate that there are reflections at a number of different heights.

THERE are two phenomena which are of special interest to the short-wave radio operator—fading and skip-distance. Fading is due to interference between the direct or ground wave and that reflected from the layer. It is particularly in evidence for short-wave radio reception during a widespread magnetic storm, but is not important for long-wave reception. Skip-distance is generally considered to be due to the fading out of the ground wave before that distance from a transmitting station is reached at which the reception by way of reflection or refraction from the Kennelly-Heaviside layer reaches the earth with considerable strength. The shorter the wavelength, the less is the distance at which the ground wave loses energy. Skip-distance varies from day to night and from summer to winter and with the frequency of transmission. During strong magnetic storms it has been found that the height of the layer is greatly increased and then it remains at an unusual height till the storm is over; later the variations in its positions become normal. During such storms the skip-distance conditions are greatly changed and stations ordinarily difficult to receive come in with ease, while others ordinarily reached become impossible to receive.

Not enough work has been done in this subject in the auroral region and other parts of the polar regions. Observations in Norway do not appear to indicate very great difference in the height of the Kennelly-Heaviside layer there and elsewhere. The Byrd expedition found extremely variable conditions which are not yet fully explained. The relation of the Kennelly-Heaviside layer to the aurora needs much additional investigation.

The relation of the aurora to solar changes is important since these are undoubtedly the source of the phenomenon. The idea has been advanced that auroras and magnetic storms are related to the eruptive solar prominences which at the time of an eclipse are seen to extend far beyond the sun, and it is thought that some of these may reach the earth. The sunspot frequency is associated with the frequency of auroras that extend to low latitudes, and there are other possible solar relations which will be brought out in the discussion of theories.

It is evident that there are a great many possibilities to be considered, and the problem of explaining the aurora is at first thought staggering. Some progress has been made, however, in developing the type of theory which it is hoped will eventually lead to complete explanations.

AS elements in the problem we have, then, the sun with its known disturbances, the earth with its variable atmosphere and magnetic field, the aurora and other allied phenomena. The evidence is fairly complete that some type of emission from the sun is responsible for the aurora, either directly or by setting up secondary effects within the earth's atmosphere. It is not unlikely that both primary and secondary effects play a part.

The simplest conception is that of a beam like a searchlight coming from a small aperture in the sun. This was one of the first ideas advanced by Birkeland. By his theory a circular pencil of corpuscular rays is shot out from the sun and traverses space until it reaches the earth's magnetic field. It has been found mathematically that the forces acting on the rays are capable of distorting the shape from a circular to an enormously elongated one with axis along the maximum auroral belt. The individual rays follow along a line of the earth's magnetic field until stopped or until so completely absorbed that the rays are no longer able to produce visible radiation. Possible paths of the rays depend upon their initial velocity and their susceptibility to deflection from a straight path.

This theory seemed so reasonable that a great deal of work has been done on it in Norway. Birkeland constructed a small magnetized sphere which he called a *terella* and bombarded it with cathode rays to see whether he could produce effects resembling the aurora. He made many thousands of experiments and among them he produced a luminous polar ring resembling the auroral belts. Störmer then joined him in submitting the results thus obtained to mathematical analysis.

Courtesy J. A. Fleming. Acting Director. Dept. of Terrestrial Magnetism. Carnegie Inst. of Washington

A SPECIAL effort was made to find trajectories for the rays which would theoretically bring them to the center of the earth, as such rays would penetrate farthest into the earth's atmosphere. Rays following this direction or departing from it only slightly can spiral along the lines of force of the earth's magnetic field, while others a little farther away may spiral around the earth, producing luminosity only after passing around the globe several times.

Vegard in 1911 began an investigation which has been carried on by Störmer and others to find whether any type of rays which had become known in connection with the development of X rays and radium would serve to explain the aurora. He was satisfied that the alpha rays of radium came nearest to accomplishing this. These start with a definite velocity and if they strike a layer of homogeneous matter they penetrate with straight-line orbits and with little scattering. He claimed that they would have sufficient penetration, but others limited the possible penetration to 250 kilometers from the earth. Besides, the auroral belt thus deduced is too near the auroral pole. Other types of rays have been tried. Chapman has worked out a combination of rays which he considers to be more satisfactory than any single type.

At this point all theories seem to come to the necessity of secondary effects. Störmer's theory calls for setting up a ring at a great distance from the earth, probably as far as the moon, and the current set up in this ring by the rays from the sun accounts for the observed phenomena. He claims that only a small change in the observed values of the earth's magnetism at the earth's surface would be caused by such a ring, but that it would bring the auroral belt to the right place. From recent radio investigations in Norway he has found that echoes have been received 15 seconds after the signals were sent out, and he considers that the radio wave has penetrated the Kennelly-Heaviside layer and has been reflected from the outer ring called for by his theory. Störmer agrees that this entire theory is not yet acceptable. He claims, however, that exceptionally strong currents in the outer ring can account for the widespread aurora.

A recent theory of a somewhat different type, though not differing greatly in fundamentals, is the ultra-violet radiation theory of Hulburt and Maris of the United States Naval Research Laboratory. They consider that the activating force is a burst of ultra-violet light from the sun. Ordinary radiation of ultra-violet light sets up the usual magnetic and auroral conditions, while unusual flares are responsible for unusual *conditions. Ionization* takes place high above the earth. Charged particles are carried from this region along the lines of force of the earth's magnetic field and for some reason give up their energy in the vicinity of the earth to produce the aurora.

It will be seen, then, that the problem of the aurora is definitely understood; that observations have been made in many fields; and that a general type of solution that may eventually prove acceptable has been established. Those who have given their lives to the study of the subject consider that we are still in a pioneer stage. The great need is for continued observations and especially for simultaneous observations of the different related phenomena in the region of the aurora.

MUCH more should be known about the within a few years if the present plans of the Polar Commission of the International Meteorological Committee, on which practically all countries doing meteorological work are represented, are carried out. The plan is to repeat after 50 years the successful Polar Year program of 1882-1883, of observations in meteorology, terrestrial magnetism, aurora, and allied subjects, with such additions as the developments of science and increased ability to penetrate the polar regions will permit. In the Polar Year of 1882-1883, 15 stations were occupied in accordance with the plans of the International Polar Conferences of Hamburg. These included Point Barrow in Alaska, and Lady Franklin Bay on Ellsmere Island, northeastern Canada. The latter is memorable for the important work done by the Greeley Expedition before it met disaster.

The plan is to reoccupy the original stations wherever practicable, and a number of additional stations. The Commission has expressed the hope that the United States, through the government or otherwise, will make, in addition to meteorological observations, magnetic and related observations at Fairbanks, Alaska, and if possible at Lady Franklin Bay. Auroral observations will be included at a number of stations in addition to the permanent observatories in Norway and the one now being operated at Fairbanks.

There is little use in making these observations unless it is certain that they will be studied. The international plan provides for such studies, and for the United States a number of organizations are taking an active interest. The Carnegie Institution of Washington, through its Department of Research in Terrestrial Magnetism, co-operates with all countries in this work and is in close touch with the work of the Coast and Geodetic Survey in terrestrial magnetism and allied subjects. The Weather Bureau and the Coast and Geodetic Survey are interested in the results which may be obtained, and all civil and military branches concerned with radio have a more or less direct interest. This also is true of many other organizations throughout the country.

OUR POINT OF VIEW

Freedmen's Slaves

THE strange travesty of slavery existing in a nation that was founded by freed or escaped slaves 100 years ago as a haven for others of their kind and given a name to symbolize forever their freedom, was made known recently when Secretary Stimson notified Liberia that if she did not clean house she would lose our friendship. It seems to be a common human failing that we should do our utmost, once we have achieved some goal or purpose, to prevent others from enjoying it or working toward it.

Britain's Markets

THE Prince of Wales sailed for Argentina in January, "taking seriously his job of salesman for the Empire." with four British automobiles, his own Moth airplane, and what-not, to "sell" Britain to South America during the exposition of British industries in Buenos Aires. This entire "push" is directed principally against American manufacturers, and since some British products can beat ours hands down, it would be well for us to look to our markets lest they slip from our hands to those of the British. The Prince i [illegible] salesman!

Ballyhoo on the Radio

RADIO listeners will overwhelmingly agree with the comments of Dr. Lee deForest on the present intolerable conditions in the broadcasting field, and radio manufacturers will do well to use their united influence to rid the air of ill-advised advertisers who are so effectually monopolizing it and automatically silencing the sets. For be it known that Mr. Ultimate Listener is the final arbiter of the air and by a turn of the switch excludes the offending program. Unfortunately this remedy automatically denies his family the programs which they expected to enjoy when the set was purchased.

We believe that if radio advertisers seriously considered the present situation they would realize that interlarding 70 percent entertainment with 30 percent advertisement does not gain the attention or good will of potential customers. Every one knows that good programs cost money and that a large part of this cost must be covered by fees from advertisers. But no paper or magazine would long survive that similarly over-emphasized its advertising; and we are convinced that the present unbalanced radio programs must be recast promptly if the popularity of programs is to be preserved. Offending concerns need only listen in on some of the well-arranged programs, where 10 percent or less of the time is given to advertisements and 90 percent or more to a carefully chosen and well rendered program, to obtain models that will cause the radio industry to thrive and enable the American listener to enjoy high grade entertainments at his own fireside.

Coast Defense

Navy on the subject of which service's air force will defend our coastline, the Army has won the honor. This seems a wise assignment of the job for, after all, the fleet would need all the planes it could muster in the event of a war. This final settlement of the question will now make possible for the first time the organization of a permanent and highly efficient system of air defense of our coasts which, by its presumed effectiveness, should add one more link in our chain of preparedness to prevent war.

Mussolini's Salesman

GENERAL ITALO BALBO, who seems ever to smile above that black beard which disguises his youth—he's in his early thirties—has called the world's attention to the progress of Italian aviation by leading a squadron of 10 planes, in military formation mind you, across the south Atlantic. Two planes crashed with a loss of five lives and two others were forced down at sea but these mishaps did not deter the youthful general. And since Italy is well represented in the population of South America, particularly in Argentina, this grand gesture by Mussolini to stimulate Italy's South American trade—for such it was—may have profitable results for Italy. At any rate, the flight showed that great argosies of the air can cross the south Atlantic carrying freight and mail. We refuse, however, to take seriously the claim made by at least one European newspaper that Mussolini did it to show the United States that he can send fleets of bombing planes to our very doors.

Imperialistic America

SENATOR ASHURST of Arizona recently proposed that we purchase a portion of Lower California and of the state of Sonora from Mexico—just like that, without so much as a by-your-[illegible]! To Mexicans, this sounded like imperialism; and it threatened to destroy much of the good will created by Ambassador Morrow. It called forth cries of "curious" and "ridiculous" and doubtless inspired unprintable thoughts. The Mexican people are not to be blamed for resenting such high-handedness for it implied that they would have nothing whatever to say in the matter. Fortunately for the relations between the two countries, the proposal was, is, and will be simply a proposal—nothing more.

International Affairs

Renewed Hope for India's Autonomy AFTER passing through several crises that seemed [illegible] eck the conference, the delegates at the Round Table in London have reached a solution acceptable to the British and Indian participants, and one that will probably be supported in Parliament by both the Labor and Liberal members. This happy outcome is a real triumph for Prime Minister MacDonald, who has shouldered the enormous responsibility of attempting this settlement. Under the provisions, control of the Army and foreign finance will remain with the Viceroy; except for these restrictions, India is granted a representative government responsible to an Indian Legislature.

When the Indian princes of the independent states definitely threw in their lot with the rest of India, the old argument, that there was not one India but several Indias, disappeared. When Lord Reading accepted the agreement for the Liberal party it was plain that any opposition in Parliament by the Conservatives would be futile, even if they would be disposed to follow the lead of Winston Churchill in opposing the demands of the Indians.

Mr. MacDonald's tactful leadership, the sympathetic attitude of the Viceroy, Lord Irwin, the unexpected harmony

(*Please turn to page* 208)

MEASURING THE ROTATION OF THE STARS

By HENRY NORRIS RUSSELL, Ph. D.

THERE must be some limit to the amount of information regarding a distant star, which can be obtained by studying the lines in the spectrum, but this limit is still far from being reached. For nearly 70 years it has been realized that from the exact positions of these lines we could find out what kinds of atoms absorb them, and so make a qualitative analysis of the star's atmosphere. It was realized too, but more vaguely, that the strong lines must be produced by abundant elements, and in recent years this knowledge has developed into a thorough quantitative analysis which tells us not only what substances are in the star's atmosphere but how much of each one, and explains many things that once were puzzling.

In sunspots, whose light can be studied with very powerful spectroscopes, most lines appear double, proving the existence of a magnetic field which acts on the absorbing atoms. This is an old story now, but it is only recently that the existence of powerful *electric* fields in stellar atmospheres has been satisfactorily established.

EXPERIMENTS in the laboratory showed years ago that when light-emitting atoms are subjected to a powerful electric force their spectral lines are split up in a complicated fashion. This "Stark effect," named for its discoverer, resembles somewhat the Zeeman effect produced by a magnetic field. For the heavier elements, and in particular for most of the lines of the metals, this effect is small, but for hydrogen and helium it is large and the separations are much wider than can be produced by any practicable magnetic fields. For the successive lines of a series (like the familiar hydrogen lines) the electrically separated components are more and more numerous and cover a wider range (which is not the case with the magnetic separation). More remarkable is the appearance of entirely new lines under the influence of the electric field, especially in helium. These lines have been identified as forbidden lines which arise from transitions within the atom, which under ordinary conditions are extremely unlikely to happen and so do not produce lines of perceptible intensity. An external electric force operates (in a manner easily explained theoretically) to break down this prohibition and make these transitions occur far oftener, so that the corresponding lines become easily visible though not strong. Now the strongest of these forbidden helium lines (at wavelength 4469.84, in the blue) has recently been definitely identified in a number of stellar spectra by Dr. Otto Struve of the Yerkes Observatory. It is near the strong helium line at 4472 but clearly separated from it, and agrees exactly with the electrically stimulated helium line and with nothing else. Two or three similar lines appear to be present in the same stars. This is a very convincing proof that powerful electrical forces are actually acting on the atoms in the atmospheres of such stars, for example, as *Gamma Pegasi.*

BUT certain difficulties arise. The first is theoretical. The atmospheres of hot stars like this are full of free electrons and consequently must be rather good conductors of electricity. How can electric forces continue to exist for even a thousandth part of a second in such a conducting atmosphere? Would not the electrified particles move about until they had neutralized the original disturbance?

The next difficulty is observational. Electric fields powerful enough to cause an appearance of the forbidden lines split up some other susceptible lines, like those of hydrogen, into widely separated components. Yet in the stellar spectra the hydrogen lines are single, although very broad and fuzzy.

The solution of the puzzle is simple enough. The electric forces in a star's atmosphere are powerful but extremely local, differing completely in amount and direction from one atom to the next. A hot atmosphere is full of free electrons and the positively charged ions from which these have been separated. Every one of these charged particles is the center of electric force and if we could pick out an atom at random in the atmosphere we should be practically sure of finding two or three charged particles among the half dozen which lie nearest to it in all directions. Once in a long time the influences of these neighboring particles will happen to counterbalance one another, but usually there will be a pretty lively electric force acting upon the atom. Great numbers of helium atoms therefore will at any moment be in a position to absorb the forbidden lines, and enough of them will do so to account for their observed intensity.

As for the hydrogen lines, if we could isolate those hydrogen atoms which at a given instant are subject to an electric field of given magnitude we would doubtless find them absorbing just the definite pattern with its numerous components which we get in the laboratory. But other atoms at the same time are subject to greater or smaller electric forces and would give more or less widely spaced patterns, and when all are at work at once these are all smeared into a single wide hazy line with no definite internal structure. After a millionth part of a second all the atoms will have shifted their positions over and over again, but the average effect will be unchanged. It is still possible, however, to tell that the Stark effect has been at work, for if it has we would expect those lines which show the widest patterns under the definite conditions of the laboratory to show the broadest smears under the chaotic disturbances in the stars.

Just this happens. Among the various series of lines into which the helium spectrum has been analyzed some show a very small Stark effect, while for others it is pronounced; and the haziness of the stellar lines varies in direct proportion to this. The hydrogen lines which show a huge Stark effect are still broader, while the practically unaffected lines of carbon and silicon are sharp in the stellar spectra.

THE whole effect of which we have been speaking varies greatly from star to star. This again might have been predicted. The denser the star's atmosphere the stronger will be the electric forces, the hazier the sensitive lines, and the stronger the forbidden ones. When we find, as sometimes we do, a star in which the forbidden lines are invisible and the rest are unusually sharp we may conclude that it or at least its atmosphere is of unusually low density. This means that we have to do with a star of unusually large diameter and great real brightness.

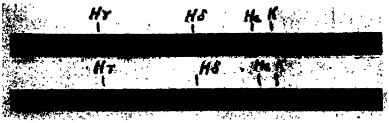
This relation between sharp lines and great luminosity has been known for years and has been used for finding spectroscopic parallaxes. With increased understanding of the physical processes this may become an important method of finding the distances of these remote stars.

Though these "pressure effects" are fairly conspicuous in the spectra, the actual pressures are very low. According to Dr. Struve's calculations the atmospheric pressure in a star that shows the effect strongly is only 1/10,000th of that of the earth's atmosphere at its surface. In the highest stars it must be far less. There is plenty of other evidence that these values are not far from the truth.

EVEN in the sun the Stark effect appears to be present for the hydrogen lines, which are normally wide and not so black as other lines of equal strength. Since there are undoubtedly many free electrons in the sun's atmosphere this might have been anticipated.

In some stars, however, the lines are widened in an altogether different way. For example in the spectrum of Altair *all* the lines are exceedingly wide, and most of them are so faint that they can be photographed only on a slow and contrasty plate and with carefully timed exposures. When this is done it is found that large numbers of lines are present, all equally wide and with fairly sharp edges (except the very wide hydrogen lines), as if the narrow and rather dark lines of an ordinary spectrum had in some way been spread out into broad faint strips with the loss of most of their depth. This is quite unlike the Stark effect, which conspicuously "plays favorites," widening some lines more than others, and when it does act produces an effect which dies away slowly so that the dark line fades away gradually without definite edges.

It was long ago suggested that this type of widening of the lines could be produced by a rapid rotation of the star. One side will then be coming toward us and the spectral lines absorbed here will appear to be shifted toward the violet, while those from the opposite limb will be equally displaced to the red. Thus all the lines will be equally widened and a simple calculation shows that they will appear as shallow but sharply bounded darker regions in the spectrum.



Above: **Spectrum of *Alpha Cygni*, a very luminous star of low density. Even the hydrogen lines H gamma, delta, epsilon, are narrow, while the metallic lines such as the K line of calcium, are very sharp. *Below:* Spectrum of Altair, a dense star in rapid rotation. The rotation widens all the lines. In each the comparison spectrum of iron is added to either side. Taken with the 100-inch telescope**

Even in the absence of rotation the spectral lines would not be indefinitely narrow nor perfectly dark. But a little more arithmetic enables one to work out just what would happen to a given observed spectral line if the star which produces it were to be set rotating at any assigned rate. Mr. Elvey (also of the Yerkes Observatory) has recently dealt with this question in a very interesting way. Using the strong magnesium line at λ 4481, which is little influenced if at all by Stark effect, and making the obviously sound assumption that in the stars where it appears sharpest the effects of rotation can be safely neglected, he has calculated what the line ought to look like in stars rotating with different equatorial speeds, and compared the results with his measures of the actual width of the line in various stars, and of the degree of blackness at different points inside it. In this way he has detected more than 20 stars which show definite evidence of rotational widening of the lines, and estimated the velocity of rotation at the equator in each case. The smallest detectable velocity is about 30 kilometers per second, a slower motion giving so little widening that it is confused with the natural breadth of the line. The most rapid motion is 260 kilometers per second in the case of *Alpha Aquilae* (Altair). Three other stars show a motion of about 200 kilometers per second and 8 or 10 more get up to 100 kilometers.

THIS tells us how fast the star's equator is moving, but not how long it takes to go round. To work this out we must know the size of the star. Fortunately we can estimate this in the very cases which are of most interest. Altair, for example, which has a large and well measured parallax, is known to give out nine times as much light as the sun. Its spectrum shows it to be considerably hotter than the sun—about 8500° on the surface as against 6000°, so that per square mile it gives off four times as much light. Hence the star's diameter must be approximately 1½ times that of the sun, or 2,100,000 kilometers, and its circumference 6,600,000 kilometers. Dividing this by the observed velocity, 260 kilometers per second, we find a rotation period of 25,500 seconds or about seven hours. This is the shortest rotation period which the observations indicate for any star.

Next comes *Delta Ursae Majoris* (the star at the junction of the bowl and handle of the Great Dipper) for which the equatorial velocity is 200 kilometers per second. This star is more than four times as far away as Altair and is actually more than twice as bright. Its probable diameter is 2,600,000 kilometers and the corresponding rotation period is 11 hours. For a few other stars the period comes out less than a day.

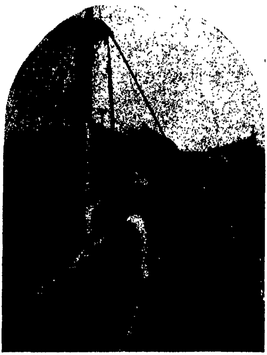
Some allowance must be made for the fact that only a part of the equatorial velocity (namely, the component in the line of sight) operates to widen the spectral lines. But, even so, it is clear that the large majority of the white stars (to which alone the present discussion applies) must take longer to rotate. Those which go round in three or four days can in due time be picked out by the methods just described (except for the few which have their poles pointing almost toward the sun). The general run of the stars for which the rotational widening is imperceptible probably have rotation periods of a week or more.

ONE further question remains. Can a star like Altair whirl so fast without being broken up by centrifugal force? The answer to this involves such simple arithmetic that it might fairly be set as an examination question for college students. From the well known relation between the real brightness and the mass of the star it appears that the mass of Altair is a little less than twice the sun's, and hence that the force of gravity at its surface is 80 percent of that at the sun's surface. The centrifugal force corresponding to a rotation period of seven hours is found to be 30 percent of the gravitational attraction.

This is considerable, but not enough to break up the star. For the planet Saturn the centrifugal force is 10 percent of the equatorial gravity and the effect is to bulge out the equator so that the polar diameter is about 10 percent less than the equatorial. By this analogy we may estimate that the equatorial diameter of Altair is about half again as great as the polar. A more rapid rotation, say in four or five hours, would probably cause the star to divide into two separate masses such as are known among eclipsing variables. But, as it is, Altair appears to be inside the "zone of safety," though not much inside. As it represents a case of extremely rapid rotation, picked out of a large number of slower moving objects, we should expect it to be near the limit and may well be satisfied with this result.

A FLOATING ELECTRIC POWER PLANT

By A. T. LITTLEFIELD
Central Maine Power Company



View of the aft deck of the *Jacona* after its conversion, showing the ship-shore cable tower

THE New England Public Service Company, having its principal office at Augusta, Maine, operates and controls about 80 generating stations in Maine, New Hampshire, and Vermont. A few of these are steam stations but most of them are hydro-electric. It also supplies, transmits, and distributes a large part of the electric service in these three states. The hydro stations are all located inland on the principal rivers. From these generating stations, transmission lines extend to many coast towns to serve the public and numerous important industries. A large part of the energy required by the subsidiaries of the company is supplied by water power but it is necessary to have a certain amount of steam auxiliary to insure continuity of service in time of drought or in case of interruption to transmission lines.

Changing conditions in certain communities are responsible for rather rapid variations in the demand for electric power. These changes require expenditures of large sums for transmission lines or construction of new plants, or possibly both, which in years may be of less service. These conditions are particularly difficult to meet in regions where there is considerable hydro-electric power which in time of drought requires the aid of steam-driven auxiliaries.

Faced with these conditions, the company has had under consideration for some time the problem of a floating power plant. After an extended investigation the company decided to purchase from the United States Shipping Board the S. S. *Jacona*, a cargo vessel of 7000 tons, 380 feet long, and 53 feet beam. This vessel has now been converted into a floating power plant by the Newport News Shipbuilding and Dry Dock Company who made the necessary changes and installed the equipment.

The propelling equipment, boilers, and engines were removed and foundations constructed to accommodate the new equipment which consists of four boilers and two turbo-generators each rated at 10,000 kilowatts. The maximum capacity of this plant is 20,000 kilowatts.

Practically all the cargo and machinery spaces are occupied by new equipment. Near the forward end of the ship is a cargo space occupied by a donkey boiler and coal bunker. This boiler will be used for heating and operating equipment on the ship when being towed. Following this is another cargo space which constitutes the boiler room. The second deck has been practically removed to make room for the boilers which extend to the main deck. In the space besides the boilers, there are two motor-driven and one turbine-driven boiler feed pumps, two oil pumps, three oil heaters, one oil transfer pump and bilge pump, and numerous boiler meters and instruments.

THE boiler equipment consists of four Babcock and Wilcox marine type boilers equipped with air pre-heaters, inter-deck superheaters, Diamond soot blowers, and oil burners. These boilers will deliver 280,000 pounds of steam per hour at 425 pounds pressure and 250 degrees, Fahrenheit, superheat. Each boiler is equipped with 11 Cuyama burners. The fuel oil is supplied to the burners at 300 pounds pressure and 300 degrees temperature. Two of the boilers are equipped with de-superheating coils. This steam will be used for heating oil and operating auxiliary equipment. The furnace walls consist of a high-grade fire brick and special insulation. There are one stack, and one forced and one induced draft fan for each pair of boilers. The fans are equipped with variable speed motors controlled from the boiler room floor. This boiler plant is designed to be operated at 83 percent efficiency.

Near the center of the ship is a built-in steel oil tank with a capacity of 250,000 gallons, or enough to supply the plant about five days at full capacity. This tank has been subdivided and reconditioned and fitted up with all necessary equipment for measuring and heat-

The switchboard and control room resembles somewhat this part of a similar plant on land, it not being necessary to crowd equipment as is usual on shipboard ing oil. On the second deck level over the oil tank are the high-pressure heaters and surge tank supplying the boiler feed pumps.

Aft of the oil tank is the old boiler and engine room. This space is occupied by one of the 10,000-kilowatt turbines and its auxiliaries. Next comes a cargo space which is occupied by the second turbine and auxiliaries. Following this is another cargo space near the stern of the ship which constitutes the switchboard room. Switching equipment is located on the second deck and a bank of transformers is mounted below.

THE turbines are General Electric Company's standard power house machines of the very latest design and are of high efficiency. They will operate at 3600 revolutions per minute on 400 pounds pressure and 250 degrees superheat, and will exhaust into surface condensers at one inch absolute back pressure. With these steam conditions, steam consumption of the turbine alone will be approximately 9.4 pounds per kilowatt at full load.

The turbines are direct-connected to the generators which have a closed system of ventilation. Cooling water for the air coolers and oil coolers will be supplied by the main circulating water pump.

The condensing equipment is furnished by the Westinghouse Electric and Manufacturing Company. The condensers are of the single pass type and the tubes are expanded at both ends. Each condenser is suspended on the turbine exhaust flange.

Condenser water connections are arranged on both sides of the ship and the main circulating water tunnel extends athwart-ship so that water may be taken in from either side.

The closed feed water system has been adopted and only the make-up water is being de-aerated. This water is de-aerated by means of a small heater and vent condenser before entering the evaporator. Fresh water will normally be used for make-up but the plant will be prepared to operate with salt water if necessary.

With the exception of a few auxiliaries, the plant is divided into two separate units. Two boilers are arranged to serve each turbine, each unit having an evaporator. low-pressure heater, high-pressure heater, and boiler feed pump, with an auxiliary boiler feed pump so arranged as to serve either system.

The generators are built for either 11,000 volts "Y" or 6600 volts delta. Leads are brought out from each winding and carried to the Allis Chalmers Reyrolle Units where the change-over is made through a plug type carriage unit.

Most of the auxiliarie are motor-driven but there are enough steam-driven units to enable the station to start up if there should be a break in the transmission lines and it became necessary to start the plant without power on the ship.

Looking aft in the boiler room. Fresh water is normally used but salt water may be used

The ship is provided with double bottom tanks for oil and water storage but these tanks will not be used at present as there is no demand for them. The forward and after peak tanks, however, are connected up for service, principally to maintain the trim of the vessel. The bilge, ballast, and oil transfer systems have been reconditioned and modified to suit the arrangement and will be similar to any other ship.

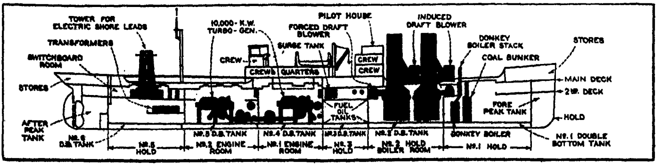
THE crew's quarters forward and aft have not been disturbed, but the midship quarters were reconditioned to accommodate 15 to 20 men when the ship is being towed. One mast was unshipped to provide room for the boiler stacks and the other kept in place fully equipped to assist in handling equipment.

The method of making electrical connections to the shore has been a problem involving considerable study. The arrangement finally decided upon consists of a steel tower on the dock and one on the port side of the ship, built on the main deck about in line with the center of the switchboard room. Arrangement is made to transfer this tower to the opposite side whenever necessary. Two separate three-phase circuits consisting of heavily armored and insulated cable will run up these towers and over a barrel cross-arm structure to the dock tower. A considerable amount of slack will be left in the cable between these towers to compensate for the rise and fall of the tide which normally is about 10 feet, but at times of severe storm may go as high as 18 feet.

Facilities for berthing have been made at Bucksport, Maine, where a large paper mill is in the course of construction. This paper mill will consume approximately 20,000 horsepower.

As the ship will have no propelling equipment it will be necessary to tow it from place to place as the occasion demands, and water, oil, and electric connections made to existing facilities ashore.

This floating power plant is really a stationary plant placed inside a ship and combined with several marine features. Being the first plant of its kind, there naturally were many problems to work out and these involved considerable study. However, the power company endeavored to make this a thoroughly modern and highly efficient plant in every way, but since it is intended to be more of a utility station and the load factor is indeterminate, they, of course, have not gone to the extreme in efficiency.



Arrangement of equipment in the converted *Jacona*

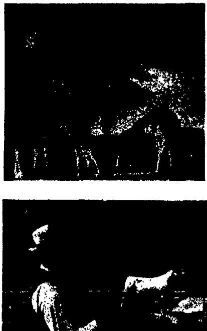
A view of a modern studio showing a variety of activities—sculpture and taxidermy

SCULPTURE AND TAXIDERMY JOIN FORCES

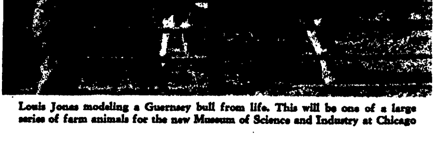
Artists coloring wax figures of giraffes for a miniature museum group. Finished group at the right

NOT far from New York City is a disused moving picture studio where another type of studio work has replaced the old time "slap-stick" comedies of two decades ago. Here the skins of wild animals are transformed into lifelike forms. In one corner an elephant is being mounted for the music room of George Eastman. In another part, miniature groups of animals are being designed and modeled in a new medium for the "friendly museum" that does not possess a deep pocketbook. Such groups are as educational as those of life size and are beloved of children and grown-ups alike. These miniatures cost less than 8 percent as much as the huge groups in which only a rich museum with plenty of space and large resources can indulge. In other words, this studio caters to the "4000" as it were, and not to the "400" which are apt to have their own extensive preparation rooms. However, there are many times when even a great museum like the Field Museum of Natural History is glad to procure, by contract, such a beautiful model or group as is shown on the opposite page.

The zoological art studio we illustrate is that of Jonas Brothers at Yonkers, New York, and one of our editors recently spent an enjoyable morning there selecting some pictures for presentation to our readers.



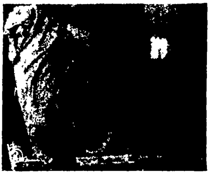
In the studios, talented young men receive excellent training while actually attacking the problem of art. No better schooling could an artist have for animal sculpture than by surrounding himself with such activities as are found in this studio. Here he gains structural understanding of the various animals and acquaints himself with the characteristics and habitat of the various members of the animal kingdom, under authentic leadership. John Jonas, famous big game hunter and explorer, is president of the studios; Louis Jonas, well known sculptor, is director of museum activities; and Leslie Jonas, mechanical

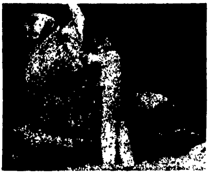


Louis Jonas modeling a Guernsey bull from life. This will be one of a large series of farm animals for the new Museum of Science and Industry at Chicago engineer, is in charge of production.

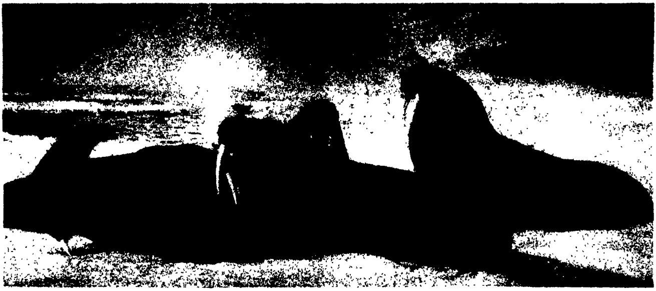
A well organized staff of artists and technicians is constantly engaged in designing and constructing animal and bird groups for natural history museums. The miniature models of mammals are on a scale of ⅛ life size. Many of these mammals are in groups, such as the giraffes illustrated. In all instances careful initial studies are made from nature or from photographs. Motion pictures are a great source of information. With the aid of special projection machinery, the animal's movements, general physical makeup, and physiology can be studied most satisfactorily. Whenever possible, models are made and the casts colored from life.

The method of mounting the walrus group is that known as the "Akeley process" which has been further developed and adapted to the mounting of walruses. The skeleton is covered with wire cloth and plaster, forming a shell over which the clay model is made. When the model assumes its general shape and size, it is coated with a soft clay composition and the skin is put on. Now the soft tanned skin is gradually worked into the clay composition until the desired lifelike texture is gained, with all the wrinkles and other fine details brought out. The skin-covered model now is ready for the mold. Plaster about one inch thick is applied directly over the skin and is reinforced with woodwork. This plaster shell holds the skin in its final place. The whole structure is turned upside down and all the skeleton, plaster core, and clay removed. The skin remains in the plaster shell and is reinforced with a durable material about ¼ inch thick. This is now allowed to dry and after several weeks the plaster shell is removed and the skin is there in its lifelike form, permanently reinforced yet light and very durable. The surface of the skin is cleaned, soaked with waterproof material, and then painted. The background is supplied at the museum where the exhibit is to be shown.





1: General shape of walrus formed with wire cloth and plaster over ——— skeleton. 2: Skin placed loosely over clay model. 3: The details are worked out by pressing the skin into the soft clay preparatory to making the mold. 4: Reinforcing the plaster mold. 5: Removing the plaster and clay core. Hide remains in mold which is reinforced with permanent material. 6: Removing last piece of mold. *Below:* Group of walruses in the Field Museum of Natural History, Chicago, Ill.



THE FUTURE OF THE ROCKET

By DAVID LASSER
President of the American Interplanetary Society

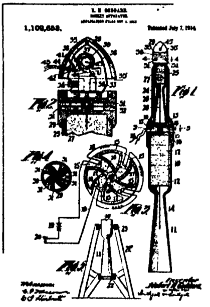
THE accompanying discussion of interplanetary rocket travel may please some, displease others. The proponents of the space rocket have not yet demonstrated its practicability but its opponents cannot demonstrate its impracticability. We shall have to wait and see, in the meantime keeping an open mind. Doubtless some of the students of the subject are rather optimistic and perhaps more enthusiastic than circumstances warrant. Still, one recalls the famous case of the great Newcomb proving that ordinary airplane flight was a physical impossibility and, eight weeks later, the Wright brothers actually flying—another fine-spun theory set at naught by a mere fact. There are enough parallels to this case to make a cautious person still more cautious about predicting the impossibility of interplanetary rocket travel.

—The Editor.

IN simplest terms, the rocket consists of a tube in which there is a chamber open at one end to the outside. In this chamber fuel, such as smokeless powder, is burned. The gases of combustion thus formed exert a high pressure in every direction. Their pressures on the side walls of the chamber balance each other, but the pressure parallel to the chamber causes two things t
The gases press upon the end wall of the chamber and, conversely they tend to rush out of the chamber through a nozzle into the open. Due to these pressures, caused by the tendency of the gases to expand, a force is exerted on the end wall, which pushes the rocket ahead.

This action does not depend on the medium, such as air, outside the rocket. In fact, the operation of the rocket is helped rather than hindered in a vacuum. Although the power obtained at the tail of the rocket may not be so great in a vacuum as in air, because in a vacuum the gases tend to expand and escape more quickly and thus lose their energy more rapidly, the reduction in head resistance, due to the absence of air, more than outweighs this factor. The air resistance against any moving body increases directly as the square of the speed. Thus the rocket is peculiarly fitted for operation at high altitudes or in open space where presumably there is an almost complete vacuum.

There are several other conditions that govern and limit the rocket's field of application. The experiments of Goddard, Oberth, and others, have demonstrated that the rocket operates at its greatest efficiency when the gases of combustion flow out of the exhaust nozzle at the greatest speed. Goddard found in his experiments that when, for example, the speed of expulsion of the gases is about 1000 feet per second, the efficiency of the fuels—the obtained percentage of their latent chemical energy—is about 2 percent. When he obtained a speed of expulsion of 7000 to 8000 feet per second, the efficiency was between 55 and 65 percent. In other words, with greater speeds of expulsion of the gases, the efficiency rises very rapidly. Furthermore, the work of these experimenters has revealed that the efficiency is greatest when the speed of the rocket approaches the expulsion speed of the gases. From this it is easily seen that the rocket is a means of transportation whose efficiency is best developed at very high speeds compared with those to which we are accustomed.



Drawing from Professor Goddard's original patent on a duplex rocket

Some of the attempted uses of the rocket doubtless are doomed to prove failures, while others may achieve a success that will astonish even the most optimistic rocket enthusiasts of today. The early efforts of Max Valier and Fritz von Opel, German experimenters, were directed toward the utilization of the rocket principle on the motor car and the airplane. Because the airplane could not be driven safely at speeds greater than 400 miles per hour, and the practical motor car was limited to about 100 miles per hour—due in both cases to the enormous friction of the air encountered at such high speeds—these experimenters soon realized that the field of the rocket was destined for other than terrestrial transportation. As has been stated, at speeds much lower than the expulsion speed of the gases, the efficiency of the rocket decreases very rapidly. Between such speeds, therefore, as 400 miles per hour, which may be the limiting speed of the airplane, and upward of 3000 miles per hour, at which the rocket must travel for a reasonable efficiency, there exists a wide gap.

WE are forced, then, to view the

operate safely at speeds approximating 3000 miles per hour, in mediums offering little resistance to its passage. Four such fields are open: first, for terrestrial transportation at high altitudes; second, for the observation torpedo; third, for the establishment and operation of a station in space; and fourth, for extensive travels into outer space and possibly to other planets.

Colonel Lindbergh has stated recently that future long distance flying will be done at high altitudes, say at 25,000 feet; for only then can an airplane be freed from the terrors of storm, sleet, fog, and snow, and be rid of the resistance of the denser, lower air. Yet the airplane is not a high-altitude machine. Its propellers must secure their traction by cutting through the air, its wings must be supported by the air, and the motor needs oxygen for its operation. To play the rôle that Colonel Lindbergh assigns to the airplane, nothing is better fitted than the rocket. With it, long distance flights become not only possible but necessary. As Max Valier has shown, a rocket ship equipped with wings could leave a Berlin airport, climb to a 40-mile altitude, and after a horizontal flight over the Atlantic

Ocean, glide slowly down to New York—all in one hour. At the 40-mile level the resistance of the air is so small, probably not more than one hundredth of what it is at sea level, that a speed of 3000 miles per hour is easily obtainable. Valier has shown that such a craft, carrying passengers, mail, or valuable express, need not have greater power than an airplane to do an equivalent job.

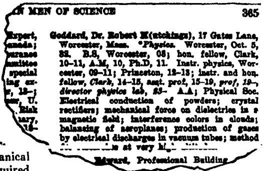
Here, then, is one important field for the rocket, a field to which its peculiarities perfectly adapt it. And as has been pointed out, it is only for long distance trips at a high altitude that the rocket can thus be utilized.

The present efforts of Dr. Goddard and the Advisory Committee assisting him under a liberal grant of funds by Daniel Guggenheim, are directed toward the perfection of what might be known n "observation torpedo," rocket carrying various devices for measuring temperature and pressure; for taking samples of air; and for photography. The torpedo will be sent unmanned to a high altitude. When the power of the rocket's upward flight is exhausted, the devices will perform their work, a para- ill spring from the cap of the rocket and allow it to descend gently to earth. These mechanical eyes can be sent aloft as often as required to any predetermined height, not only to gather weather information invaluable to aviation and commerce, but also more general information of value to science.

BUT the observation torpedo has its limitation—it is a costly process to send these rockets aloft continually, especially when the area to be observed is so great. Otherwise, the particular data obtained will be of only local and transitory value. What has been proposed to serve to supplement the purposes of the observation torpedo is the "station in space." This conception we owe to Hermann Oberth of Mediasch, Germany.

Herr Oberth proposes that we take advantage of the dual forces of gravitation and centrifugal force to send a rocket aloft which shall circle continually around the earth. Rising to a height of about 500 miles, equipped with all manner of observation devices, the rocket will acquire a speed of some five miles per second parallel to the earth's surface and then, with power shut off, it will continue to circle the earth indefinitely, unless destroyed. From this "station," which will encircle the earth every two hours, a scientist-observer will watch cloud movements, observe the stars, note changes in the sun with their resultant effect on terrestrial weather, radio communication and other electric phe- ια; and gather valued information.

The observer or observers in this "station in space" will maintain communication with the earth by radio or, if that is not possible, by light signals. Relief and supplies will be furnished by an auxiliary rocket sent from the earth. As many stations may be established as desired, each, of course, covering a circumferential segment of the terrestrial sphere. Such studies of outer space as are made possible by the observation torpedo and the "station in space" must of course precede attempts to conquer outer space and make a journey to the moon or to some other planet. Only by a precise knowledge of the conditions existing in free space (temperature, pressure of atmosphere, if any, existence and field of activity of meteors and cosmic rays) can man plan to build a ship capable of making an interplanetary journey and to protect himself against adversity.



N MEN OF SCIENCE 365

Goddard, Dr. Robert H(utchings), 17 Gates Lane, Worcester, Mass. **Physics.* Worcester, Oct. 5, 82. B.S, Worcester, 08; hon. fellow, Clark, 10–11, A.M, 10, Ph.D, 11. Instr. physics, Worcester, 09–11; Princeton, 12–13; instr. and hon. *fellow, Clark*, 14–15, asst. *prof*, 15–19, *prof, 19–, director physics lab, 23–* A.A; Physical Soc. Electrical conduction of powders; crystal rectifiers; mechanical force on dielectrics in a magnetic field; interference colors in clouds; balancing of aeroplanes; production of gases by electrical discharges in vacuum tubes; method [illegible] at very hi[illegible]

Edward, Professional Building

Courtesy The Science Press (New York)

For such an ambitious trip as the latter, the rocket is the only means thus far devised. The properties of the rocket which would fit it for high altitude transportation and for extra-terrestrial observations, also would fit it for long journeys to other worlds. The speed of nearly seven miles per second necessary to escape the gravitational attraction of the earth is well within reason, and a solution is possible by the use of the detachable rocket.

In the detachable rocket the space ship will have attached to its tail, in railroad car order, two, three, or more separate rocket motors. When the ship leaves the earth the last or tail rocket (which naturally is the largest) will be put into operation and bring the rocket up to a predetermined speed, say two miles per second, before it is uncoupled and by means of a parachute allowed to drift back to earth. The rocket remaining at the end is now operated and the speed of the ship is increased to four miles per second before its fuel charge in turn is exhausted. It, too, is uncoupled; and so on, until only the ship proper and a non-detachable rocket are left. Before the last remaining fuel is exhausted, the rocket already has a speed sufficient for it to escape the earth and on a predetermined course to travel to another planetary body.

Bachrach

Professor Goddard and biographical record in "American Men of Science"

Some of those who admit the possibility of a rocket ship traveling, say, to the moon, assert that no return for the ship is possible—for fuel can not be carried for the round trip. Even if this were true, in the light of fuels now available, that would not of itself place a barrier against an interplanetary journey. Granted that funds for the construction of rockets were available, and that a trip to the moon were contemplated, perhaps a dozen small rockets could first be dispatched, each carrying, in addition to the fuel and supplies for its own trip to the moon, a small additional amount. These rockets would all land in the same lunar neighborhood and when the main rocket arrived it would gather the surplus fuels from the small rockets, for its return trip. The small rockets would remain on the moon or else be salvaged.

FREQUENTLY I am asked, "Granting that a trip to the moon is possible: how then can your space travelers exist on that airless, waterless globe; and how can they return to earth?" These questions are fair, and they demand an answer. However, I can point out only the scientific principles; I can not give an engineering blueprint of the answer, for the particular answer must depend, very largely, on discoveries which must first be made on the nature of extra-terrestrial space, and on further research of the moon. The 200-inch telescope now being constructed may, for example, upset our present notions of the nature of the lunar surface.

For existence on the moon, where there is no air—no pressure to equalize that which our bodies are accustomed to on earth, namely, 14.7 pounds per square inch, and no water vapor—artificial equipment obviously is neces-

Fritz von Opel, the German manufacturer and rocket car experimenter, with Frau von Opel

y. A f equipment which would provide all three necessities could very well be a rigid diving suit used by deep-sea divers. The weight of the equipment need not be a handicap; in fact it would be an advantage. Since the gravitational pull on the moon's surface is only one sixth that on the earth's surface, a terrestrial being must have some extra weight to ballast himself on the moon in order to walk or move about without discomfort. A suit made of almost any metal, flexible enough to permit bodily movement and provide an equalizing pressure of 14.7 pounds per square inch against the body, might serve. Artificial air with the proper amount of oxygen would be kept in the space flyer and a form of gas mask in the space suit would be filled with it each day.

I have not counted on replenishment of supplies from the moon but, even assuming that there is no pure oxygen or water on it, there is no reason to assume that salts and mineral rocks can not be broken down to provide oxygen and water. The first trips made to the moon will be merely journeys to provide a quick inspection of lunar conditions, with a rapid return to earth. Only after these conditions have been determined in full can a more extended stay, to reap some of the advantages of interplanetary travel, be made.

Another serious obstacle to existence on the moon is the extreme temperatures prevailing. During the lunar day, which lasts two weeks, a space traveler would be exposed to the full solar heat; and during the two-week lunar night he would have to exist at an extremely low temperature.

If the space suit were double walled, with a vacuum between the walls, body temperature might be preserved to a certain extent. The space ship also should be double walled and provide its own heating system for the long cold nights. For relief from the heat of the sun, advantage might be taken of the shade offered by the deep lunar craters, or a migration to the "terminator" of the lunar surface where the sun was just above the horizon. Here, a more or less equable temperature should prevail and, by keeping step with the comparatively slow movement of the moon in relation to the sun, the space ship could be kept continually near the dividing line between day and night.

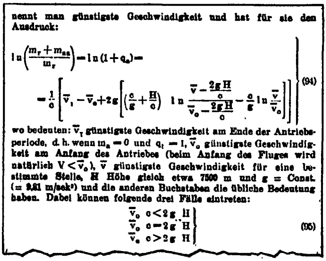
For the return to earth, one method already has been pointed out: sending a number of auxiliary rockets each carrying a surplus of fuel for the return journey of the main rocket. The amount of fuel necessary, of course, would be much less than for the journey to the moon, for on the return, on leaving the moon, the space ship need combat a gravitational pull only one sixth of that of the earth. Furthermore, the earth itself would begin to aid the space ship when it had traveled only about 24,000 miles from the moon. Thus, the escape from the moon to the earth would need considerably less than one fiftieth of the power required for the earth-moon trip. The return trip need not, then, cause serious difficulties, for if no space ship can be designed that can carry one fiftieth of its fuel as reserve, a trip to the moon would be sheer suicide in any event.

The answers given here are merely suggestions of the ultimate solutions. It is enough to say that the basic scientific principles involved are sound.

THE application of man's ingenuity, and his use of the manifold resources of nature in extending the power and use of the rocket, has but begun. As the skepticism of the world gradually dissolves and more and more experimenters are attracted to the possibilities of making original contributions to this new art, our control over the rocket should be extended geometrically.

I foresee, being steadily leveled under the assault of determined and far-visioned technicians, the problems of the finding of new and more powerful fuels, the control of these fuels, and the question of the stabilization of the rocket in flight.

If we are not to be appalled by the difficulties in harnessing the giant that slumbers in the rocket, it can open up a new era of our conquest over nature; we must decide whether the game is worth the candle. My own answer is an emphatic "yes!" In any event, the rocket is here to stay. It has a field of usefulness given to no other instrument, and by the intensive exploitation of its usefulness the ultimate conquest of space should prove possible.



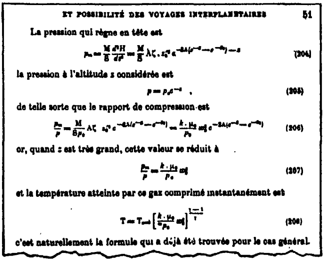
nennt man günstigste Geschwindigkeit und hat für sie den Ausdruck:

$$\left.\begin{aligned}\ln\left(\frac{m_r+m_{ss}}{m_r}\right)&=\ln(1+q_s)=\\&=-\frac{1}{c}\left[\bar{v}_1-\bar{v}_0+2g\left[\left(\frac{c}{g}+\frac{H}{c}\right)\ \ln\frac{\bar{v}-\frac{2gH}{c}}{\bar{v}_0-\frac{2gH}{c}}-\frac{c}{g}\ln\frac{\bar{v}}{\bar{v}_0}\right]\right]\end{aligned}\right\}\quad(94)$$

wo bedeuten: $\bar{v}_r$ günstigste Geschwindigkeit am Ende der Antriebsperiode, d. h. wenn $m_s=0$ und $q_t=1$, $\bar{v}_0$ günstigste Geschwindigkeit am Anfang des Antriebes (beim Anfang des Fluges wird natürlich $V<\bar{v}_0$), $\bar{v}$ günstigste Geschwindigkeit für eine bestimmte Stelle, H Höhe gleich etwa 7500 m und g = Const. (= 9,81 m/sek²) und die anderen Buchstaben die übliche Bedeutung haben. Dabei können folgende drei Fälle eintreten:

$$\left.\begin{matrix}\bar{v}_0\ c<2g\ H\\ \bar{v}_0\ c=2g\ H\\ \bar{v}_0\ c>2g\ H\end{matrix}\right\}\quad(95)$$

Typical pages from foreign technical treatises on rocket flight, showing that physicists, engineers, and mathematicians have given more serious attention to the technical problems involved than many realize. This is especially true of the Germans and French, in whose languages a large literature on the subject exists, and who are ahead of us in rocketry



ET POSSIBILITÉ DES VOYAGES INTERPLANÉTAIRES 51

La pression qui règne en tête est

$$p_m=\frac{M}{S}\frac{d^2H}{dt^2}=\frac{M}{S}\Lambda\zeta_\cdot z_0^2\,e^{-2A(e^{-z}-e^{-z_0})-z}\qquad(204)$$

la pression à l'altitude z considérée est

$$p=p_0e^{-z}\ ,\qquad(205)$$

de telle sorte que le rapport de compression est

$$\frac{p_m}{p}=\frac{M}{Sp_0}\Lambda\zeta\ \ z_0^2\,e^{-2A(e^{-z}-e^{-z_0})}=\frac{k\cdot\mu_0}{p_0}\omega_0^2\,e^{-2A(e^{-z}-e^{-z_0})}\qquad(206)$$

or, quand z est très grand, cette valeur se réduit à

$$\frac{p_m}{p}=\frac{k\cdot\mu_0}{p_0}\omega_0^2\qquad(207)$$

et la température atteinte par ce gaz comprimé instantanément est

$$T=T_{\text{amb}}\left[\frac{k\cdot\mu_0}{\varpi p_0}\omega_0^2\right]^{\frac{\gamma-1}{\gamma}}\qquad(208)$$

c'est naturellement la formule qui a déjà été trouvée pour le cas général.

L'Explorati

de France, P

SCIENTIFIC PROGRESS IN 1930

Alarms—True and False

THE editor frequently is asked to "name the most significant scientific event of the previous year." This he cannot do. Nobody can. True, it is possible, often by following the line of least effort or perhaps, being motivated by some journalistic aim, to name and recompense with a prize *an* event in science which after so short a lapse of time has the outward appearance of being the most outstanding—if only one which has made a big noise in the newspapers. But future historians alone will be in a position to select *the* most significant scientific event of 1930 or any year.

Who, for example, could and would have selected as early as the following winter the most significant scientific event of 1831, Faraday's research on induction? Only many years later was this simple little experiment clearly seen to have been the progenitor of the world's whole 90-billion-dollar electrical industry. How many, on the other hand, if foolhardy enough to engage in this premature picking pastime, would be likely to select discoveries destined later to be regarded as "false alarms"?

Thoughtful persons will not seriously make this attempt.

We publish this month a part of the annual *Science Service* summary of the past year's happenings in the world of science, pointing out however that, if the past provides a criterion, only a fraction of these researches later will turn out to have afforded major contributions to knowledge. As time elapses and a maturer viewpoint thus is gained, we shall endeavor—as we always do—to present carefully weighed accounts of those few scientific discoveries which, after running at least the first gauntlet, are seen to be candidates of major importance.—*The Editor*

Aeronautics

The highest altitude ever reached by man was attained by Lieut. Apollo Soucek, naval flyer, when he climbed to 43,166 feet, more than eight miles.

The difficult east-west crossing of the Atlantic was successfully made by Captain Dieudonné Coste and Maurice Bellonte in the *Question Mark*, flying from Paris to New York in 37 hours, 18 minutes.

An expanding rubber leading edge for airplane wings, called "airplane overshoes," to prevent the formation of ice on the wings, was invented by Dr. William C. Geer, of Cornell University.

Captain Frank M. Hawks took just 12 hours, 25 minutes, 3 seconds to cross the continent from Los Angeles to Valley Stream, Long Island, setting a new record; the time included three stops of 15 minutes each.

The world's largest airplane, the German *DO-X*, made successfully its first long distance flights.

A new refueling endurance flight record was set by Forest O'Brine and Dale Jackson in the *Greater St. Louis* at 647 hours, 28 minutes, 30 seconds.

The Curtis Tanager, with its automatic wing slots and floating ailerons, won the 100,000-dollar prize of the Guggenheim Safe Aircraft Competition.

The world record for duration without refueling was established by two Italian flyers, U. Maddalena and F. Cecconi, at 67 hours and 13 minutes; they also made the record for distance in closed circuit, 5088.27 miles.

Dr. Hugo Junkers completed and put into operation his huge flying wing, a plane carrying more than three tons, with a cruising range of 2000 miles, in which space for engines and passengers, cargo and fuel is made an integral part of the wing.

An unofficial world record for a duration flight in an engineless plane, was made by Jack Barstow at Point Loma in California, when he glided for 15 hours, 13 minutes in a sailplane.

The large British airship *R-101* was destroyed by explosion in a storm in France.

The first attempt to come to earth on a glider launched from an airship, was successful when Lieut. R. S. Barnaby descended from the airship *Los Angeles*.

With a flight from Ireland to the United States, Capt. Charles Kingsford-Smith and crew in the *Southern Cross* completed a trip around the world.

A non-stop flight of 3400 miles from Cardington, England, to Montreal, Canada, was made by the airship, *R-100*.

An unofficial world speed record for airships was set by the *R-100* at 81.5 m.p.h.

Photographs taken at a distance of 270 miles from the subject by Capt. A. W. Stevens in an Army plane set a new record in long distance aerial photography.

The women's altitude record was set by Miss Elinor Smith, 18 years old, at 27,418 feet, more than five miles.

Captain Wolfgang von Gronau and three companions made the first east-west seaplane crossing of the Atlantic by way of Iceland and Greenland.

The first woman's solo flight from England to Australia was accomplished by Miss Amy Johnson.

A world's speed record for women was established by Miss Amelia Earhart at the speed of 181.157 miles per hour.

An 1800-mile air line, from Ft. McMurray near Edmonton, Alberta, to Aklavik on the Arctic Ocean, was put in operation.

Anthropology and Archeology

An elaborate system of canals built by Indian engineers in Arizona about 1200 A.D. was photographed and surveyed by an airplane expedition directed by Neil M. Judd, archeologist of the United States National Museum.

In an almost inaccessible region of the Kuskokwim River, Dr. Ales Hrdlicka, of the Smithsonian Institution, found 3000 living Eskimos belonging to the old, original type, quite unlike the present race of Eskimo.

Evidence that the Maya understood the false perspective was found at Uxmal buildings by the Tulane University Expedition; additional buildings and 19 important date stones were discovered at Uxmal.

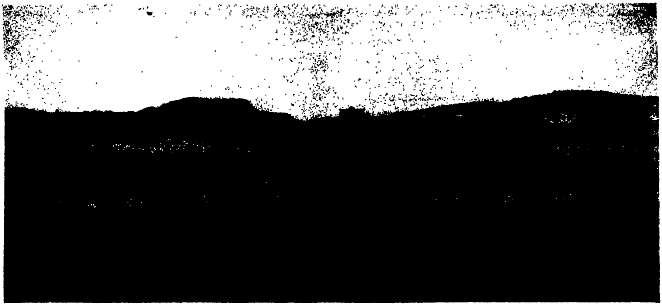
Highly accurate predictions of eclipses of the sun and the moon were made by the Mayan Indians eight centuries before Christ, Dr. Herbert J. Spinden, of the Brooklyn Museum, discovered.

Clearance of ancient ruins in Rome continued, with the removal of modern buildings to display the old buildings to better advantage.

Evidence of 1000 years of Biblical history, from 1600 B.C. to 587 B.C., was found in a single mound at Tell Beit Mirsim, in Judah, it was reported by Prof. William F. Albright.

Indian artifacts lying under a layer of ground sloth refuse were found by

(*Please turn to page 209*)



A modern motor car at the ruins of ancient Pachakamak. The temple is 15 miles inland from Lima, Peru

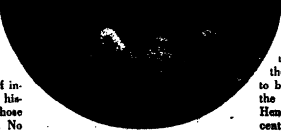
THE MECCA OF ANCIENT AMERICA

By A. HYATT VERRILL

COVERING hundreds of acres of the desert that stretches from the sea to the Andean foothills, bisected by the modern motor highway from Lima, 15 miles distant, to Pisco, are the ruins of the ancient city of Pacha-Kamak. Everywhere are the massive walls of adobe bricks, the crumbling remains of great palaces, storehouses, and public buildings, the cubicles that mark rows of houses, the extensive plazas and ball courts, the public baths, and the shops, shrines, and market-stalls. Everywhere one may trace the once-busy streets, the broad highways, the narrow paved lanes.

A little apart, and isolated from the other ruins, is the temple of the *Mamakunas* or Virgins of the Sun, still well preserved with its lofty central altar, its cells that once housed the sacred virgins, its hallways and stairs, and its oddly Egyptian-like niches within which, in the long-forgotten past, stood magnificent images or idols ablaze with gold and jewels. And, dominating all, covering the summit of an immense artificial hill, is the vast temple of Pachakamak, the supreme god, the Creator, the Almighty of the Incan and pre-Incan races.

No ruins in all South America, if indeed in the New World, hold more historic and romantic interest than those of this holy city of Pachakamak. No one can say when the city was first established, no man even can guess at its age. It may be five thousand, ten thousand years old; but we know that, centuries before the days of the first Inca, Pachakamak was an ancient city; that it was a sacred spot, a holy city, the Mecca of the South American races; and that, from far and near, from points as far distant as Colombia and the Argentine, pilgrims journeyed to this Mecca of ancient America to worship at its temple, to pass their last hours within its sacred precincts, and to be buried in its consecrated ground. So firmly established had its sacred character become, so reverenced its temple and its shrines, that the Incas made no attempt to suppress the ancient rites and religions that were followed at Pachakamak, and instead of forcing the people to adopt the Incan faith and worship *Inti*, the Sun-God, they erected their own Temple-of-the-Sun on a hill adjacent to that of the temple of Pachakamak. Hence the city became a Mecca for the people of the Incan faith as well as for the others, and the immeasurably ancient god of the pre-Incas and *Inti*, the Sun-God, were worshipped side by side.



Mining for mummies near the temple in the great ruined city of Peru

NOT only did the people come to Pachakamak to worship; throughout the length and breadth of South America—even in far distant Central America—the image of the supreme god was credited with working miracles and of curing the crippled and the ill. Men and women barely able to crawl up the temple stairs, or so weak with illness or with injuries that they were carried by others, emerged from the holy presence strong, whole, and well. In addition, the image of the god was believed to utter oracles and prophecies, while the faithful desired nothing more than to be interred in the sacred ground of the vast cemeteries about the temple. Hence it is no wonder that through centuries—thousands of years—the desert sands about Pachakamak should have become a vast necropolis literally filled with the mummified bodies of the dead, and that the temple and its shrines should have been enriched by the gifts and offerings of pilgrims until it was reputed—and no doubt rightly—to have contained a greater treasure than even the famed Temple-of-the-Sun at Cuzco, the Incan capital. In fact, it was the stories of the wealth of Pachakamak that lured Pizarro to Peru, for tales of its riches in gold, silver and precious stones had spread northward to Panama and beyond.

Façade of the temple. An idol stood on the top of each bastion and the niches below held others. The walls were ten to 80 feet thick

A grand and imposing sight the famous temple must have presented before the days of the conquest. And almost incalculable must have been the time and labor devoted to its construction. The hill upon which it stood, a miniature mountain, was built entirely by hand, of adobe bricks and faced with squared blocks of stone. How many centuries went into the making of this gigantic mound, how many men toiled and labored at it, how many millions of bricks and stones went into its construction, are beyond computation. But the probability is that it was erected gradually, little by little, through countless centuries.

UPWARD from the base—more than two miles in circumference—a flagged stone ramp extended in a spiral. At every turn was a shrine or small temple and a short flight of stone steps that led to the next turn. As the pilgrims and worshippers ascended the huge mound they stopped at each of these spots to pray and make offerings. Everywhere rose the massive stone-faced walls, sloping inward toward their tops, rising in tiers like a modern "zoned" skyscraper, and everywhere covered with red or yellow stucco and elaborate frescoes.

Along the topmost wall bordering the last portion of the ramp, facing the Pacific, was a line of immense stone statues rising above niches in which were smaller images of wood covered with plates of gold. At the very summit of the temple was a huge rectangular level court or plaza surrounded by ornately sculptured walls with niches in which were more than one hundred sacred and symbolic figures gleaming with gold and silver and ablaze with gems.

In the center rose the holy of holies, the most sacred of shrines in all the New World, a small rectangular structure of stuccoed and frescoed stone, containing the idol or image of the almighty Pachakamak, Creator of Heaven and Earth, Ruler of the Universe—a wooden image of gigantic size so laden with gold and precious stones that it was scarcely visible. The timbers and woodwork, as well as the doors to the various shrines, were of hardwood fastened together with gold nails, and the massive portals of Pachakamak's shrine were completely covered with magnificent mosaic work of turquoise, mother-of-pearl, rock crystal, coral and semi-precious stones.

When the ruthless, destructive Spaniards under Hernando Pizarro reached Pachakamak—having been sent from Cajamarca by Pizarro in order to secure the treasures that were to form a portion of Atahualpa's ransom—they found little of value in the temple. Word of their coming had been carried to the city, and the priests of the temple had hurriedly stripped the idols and images of all precious metals and precious stones and secreted them. To be sure, the idols and images were still there, the magnificent mosaic work adorned the doors, and the Dons found a few bits of gold and two or three emeralds that had been dropped by the priests and overlooked. Still the Spaniards did not return empty-handed. Having torn down and destroyed every image, idol, and statue they could find, after erecting a cross upon the temple's top they piously proceeded to torture the priests in an effort to force them to reveal the hiding place of the temple's riches. In this they were partially successful. One priest, unable to withstand the agonies imposed by his inhuman captors, told of a horde of silver in a storehouse

Another view of the temple, showing one of the cuts made by the treasure seekers. A syndicate was formed for the exploitation of the imagined "buried treasure" beneath the gr structure and it has been ruthlessly damaged by their

(which still stands) and of gold and silver buried near the temple. But though this treasure was in itself a fortune—so great was the quantity of silver that the Dons shod their horses with that metal—yet it is believed to have been but a drop in a bucket as compared with the riches that had been hastily removed and which never have been found. One of the Spaniards also discovered the gold nails in the woodwork, and when the latter had been burned and the precious spikes had been raked from the ashes, they were found to weigh 32,000 [illegible] roughly half a million dollars in value.

Remains of a fifteen-foot stairway to the shrine of the temple—sadly damaged by the vandals

From that day Pachakamak was doomed. Deprived of their most venerated deity, with much of their temple and their city wantonly destroyed, and with alien men and an alien faith established in the ancient, holy city, the natives deserted it. As no more pilgrims journeyed over deserts and mountains, through torrid jungles and over arid plains to worship at the desecrated shrine, Pachakamak soon became but a memory of the past, a dead and ruined city tenanted only by the soft-winged burrowing owls, the soaring black vultures, and the desert rats. The thatched roofs of the buildings decayed, fell in and vanished in impalpable dust; the adobe walls, uncared for, exposed to the elements, crumbled and fell apart; the Spaniards tore down the temple walls and used the cut stones to build their tawdry dwellings in the neighboring valley of Lurin, and where once were green, tilled fields and gardens the desert drifted in until today the ruins of the city stand in a glaring, barren waste of sand. Alone with its countless dead the forsaken city lay silent in the shadow of its once magnificent temple, an accusing monument to the ruthless destructiveness of the Spaniards.

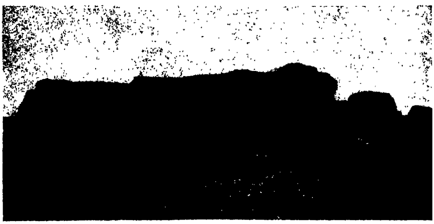
BUT even the dead could not be left in peace. Everywhere men dug where, for thousands of years, the bodies of the faithful had been laid to rest, because gold and silver sometimes were buried with the corpses. Ruthlessly the cotton-wrapped mummy-bundles were dragged from the graves, feverishly the cloths, the priceless textiles and the garments were torn from the shrivelled, desiccated bodies and these, torn limb from limb, were scattered about, tossed aside, trodden underfoot. Treasure seekers, archeologists, curio hunters and tourists—all have played their part until there is scarcely a square yard of the sand in or about Pachakamak that has not been turned over. In many places the desert looks as though it had been exposed to shell fire. Everywhere are the great pits, the crater-like depressions where graves have been excavated, and everywhere are the skulls and bones, the human hair, the fragments of textiles, and the broken pottery that have been disinterred and cast aside. In many places the skulls form veritable windrows, and one can scarcely move anywhere without treading at every step upon human remains.

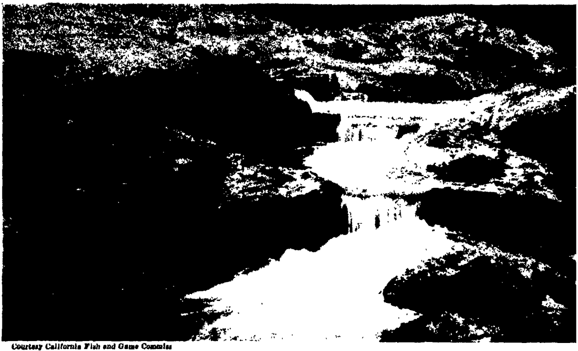
Bad as this was, the worst was yet to come. Up to the past year the great temple upon its artificial hill had remained almost intact. To an extent, time and the elements had left their marks upon it. Most of the frescoes and much of the stucco had disappeared, little of the sculptured stone and adobe remained, and vandals had scribbled their names and had painted advertisements upon it in places. But the walls still stood, solid, massive, impressive. The ramp could still be traced and afforded a pathway to the summit, and one could trace the outlines and details of the shrines and visualize it as it was in its heyday. The stairways were as perfect as on that day when Hernando Pizarro, sword in hand, dashed past the protesting priests and, bursting into the sacred cubicle, with characteristic bigotry hurled the venerated god over the temple walls.

Within the past year this most famous and most historic relic of Peru's ancient civilization, the temple itself, nearly 1800 by 1500 feet in dimensions, has fallen to the insatiable lust for gold that still fills the hearts and minds of many of the descendants of the Spanish conquerors. Some charlatan claimed to possess an ancient document telling of vast treasure buried beneath the temple. A syndicate was formed and a gang of men was put to work tearing it down, undermining its walls, destroying the stone facings and tunneling into the hill itself.

IN vain were the protests of those interested in preserving this magnificent relic of the Incas and pre-Incas. Soon great gaps appeared in the ancient walls, columns and stairways that were ancient when Pompeii was built, fell crashing in clouds of dust down the hillside, and shrines were reduced to piles of débris. It is the greatest pity that the money and the energy expended in this destruction was not devoted to reconstruction, that the government of Peru did not realize the inestimable historic and scientific value of preserving the temple for all time.

The saddest part of this wanton destruction is that the destroyers will have accomplished nothing aside from the destruction of the temple. No gold, no treasure will reward them, for it is beyond the bounds of reason or of credibility to suppose that valuables would have been concealed under the temple in the heart of that stupendous pile of adobe bricks. To have done so would have been practically impossible without leaving obvious traces, and had there been such traces the avaricious and keen-eyed Spaniards would have seen them and would have left no stone upon another until they had unearthed the hidden treasure.


The temple of the Virgins of the Sun at Pachakamak. No one knows who first built the city whose bottom layers, many yards beneath, have not been excavated



Courtesy California Fish and Game Commiss

A "stair-case" of pools, known as a fish ladder, around the end of a dam

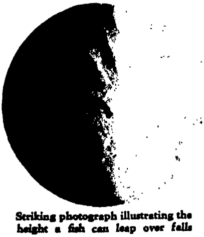
MIGRATING FISH 'CLIMB' FISH LADDERS

By CHARLES W. GEIGER

ONE of the interesting features of hundreds of power and irrigation dams on the rivers and streams of California are the fishways or fish ladders which are built for the purpose of aiding migrating fish on their journey to spawning areas to pass dams in the streams. Fishways, or ladders, generally consist of a series of pools, rising like steps from near the downstream base of a dam to the crest, the water flowing through the pools in an even amount. The migrating fish jump out of the water, clearing the flow of water from one pool upward to the next. Here they usually rest for a short time before attempting to make the jump to the next pool above. These fish often jump to a height of four or five feet and cover a horizontal distance of six to eight feet.

IN the great majority of California streams, the fish ascend the streams during the spawning season to reach their natural and most favorable breeding places. They also move from one part of the stream to another in search of food, as well as to adapt themselves to temperature conditions. During the fall and winter the fish descend to the lower reaches of the large rivers that drain the Sacramento, San Joaquin, Kings, Kern, Kaweah, Tule, Klamath, Eel, and other river basins. If their movements are obstructed by dams, the natural propagation is seriously affected. Their movements to the upper reaches of the streams when the temperature rises are also prevented by dams which do not have fishways.

The work of maintaining efficient fishways over dams becomes more important as the number of dams being built by the hydro plants and irrigationists increases. Maintenance of efficient fishways in California is carried out by the Bureau of Hydraulics of the California Fish and Game Commission. This Bureau, now in charge of Mr. John Spencer, was formed by the Commission in June, 1926. For the first seven months the Bureau of Hydraulics was concerned with fishway and fish screen installations, but early in 1927 pollution control, or prevention of pollution, of public waters was added, and at the present time the Bureau is considered one of the most important departments of the Fish and Game Commission. Fishways are inspected periodically by deputies of the Commission.



Striking photograph illustrating the height a fish can leap over falls

California law states that fish ladders shall be constructed when, in the judgement of the Commission, one is required or, in lieu thereof, a hatchery may be constructed or fry planted. The practical working out of these provisions is that many of the owners of the high dams escape their obligations to the state and do nothing for fish life or its perpetuation, except as the reservoir formed may be of aid. This is brought about due to the fact that fish ladders, as far as present information goes, may be installed on dams only up to about 60 or 70 feet in height; hence dams beyond these heights are not provided with fish ladders, and hatchery construction must be resorted to or fry planted as covered by the law. After the owner of the dam constructs a hatchery it is turned over to the state, and the Commission takes care of its operation and maintenance.

THE highest dam in California over which fish pass by means of the fish ladder, is the San Clemente, which is 70 feet high. The fish ladder built at this dam consists of some 35 concrete pools each pool above the first being about two feet higher than the preceding one. Fish ladders are usually constructed of concrete or wood, redwood or pine being used in many instances.

Unless water is to be passed by a dam to maintain fish life below, it is not always necessary to have a fish ladder in continual operation. It is essential, however, that a ladder shall be in operation at all times during fish migrations. Some streams in California are dry in the summer months, yet in the fall, winter, and spring these streams do much to promote fish life, for fish ascend, spawn, and hatch and the fry returns before the stream becomes dry. Dams on such streams require fish ladders as well as do those on streams that flow continually.

A fishway of considerable importance is that of the Anderson-Cottonwood Irrigation District on the Sacramento River at Redding. This dam had formed a barrier to migrating salmon and steelhead for seven years and only a small number of fish had succeeded in passing. A change in the plan came as the result of a harmonious conference, and construction of the fishway followed. Now the migrating salmon and steelhead easily pass upstream. An effective barrier to migrating fish can stop the run up that stream and in a few years make the stream above practically barren of migrating fish. The recent installation of three fishways on dams on coast streams in Mendocino County, opened up a large area which had been closed for many years to spawning fish.

In all cases of fish ladder construction, an effort is made to have the entrance to the ladder as close to the base of the dam as possible, picking out the side of the stream that the fish generally use. This is because they sometimes seem to prefer one side of the stream rather than the other. The entrance to the ladder, however, and all pools of the ladder, should be free from any overpour of the dam. The trout will search more thoroughly than the salmon to find the ladder. Therefore if the Commission is designing one for steelhead and other forms of trout they do not have to comply so closely to this principle of locating the entrance close to the base of the dam. Salmon usually come to a dam and do not, generally speaking, drop downstream afterwards; hence the entrance to the fish ladder must be in such a position that it can be readily found.

Courtesy California Fish and Game Commission

Rotary fish screen on an irrigation ditch and, at far end of dam, a three-jump fish ladder

The type of fish ladder generally used is the pool type and has been found successful when properly installed. Due consideration must be given to all factors, such as size of pool in proportion to the size of the fish, amount of water in the pool, amount of water passing through, width of port, and height of the jump or difference in elevation between the pools.

The usual sizes for pools are four feet by six feet and six feet by eight feet, although for large fish, such as the larger salmon, pools have been made of considerably larger size. The openings from one pool to another are generally all on line, that is, they are not zigzag, or staggered from one side to another, although departures are made from this straight line whenever it is found necessary. The pools may be in line or may, by taking advantage of natural conditions both for economy and practicability, wind back and forth across the slope but changes of direction are to be avoided as much as possible.

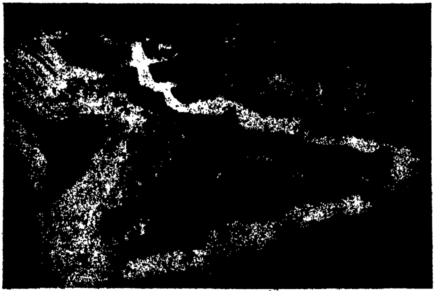
The difference in elevation between the pools or jumps does not run over 2½ feet and decreases to one foot or less. These differences in elevation are determined by the weight of the fish, the amount of water, and often by the obstacles overcome before reaching the ladder. If it is thought that the fish have used considerable energy in the upstream migration, then an effort is made to have the jumps in the ladder as small as possible.

All pools are designed to have a depth of at least two feet so that the fish may rest. The largest size of the pools is in the direction of the jump, and the pools are protected either by high walls or by wire mesh so that fish, if they do not jump straight, can not get out of the pool. The ports or openings from one pool to the next are figured to have a lip of not over six inches in width and an effort is made to have the lip similar to the crest of a weir, as it has been found that when lips are wide the results are not as satisfactory.

The amount of water running through a fish ladder is of importance. There can be too much water and also too little. This can be determined by observing the actions of the fish. Too turbulent a condition is not advisable although sufficient water should come through so that fish will be attracted.

Fish screens are as necessary to preserve fish life as fish ladders are necessary to help fish in their upstream migration. If the young salmon in their migration down stream are permitted to pass into irrigation ditches and thence on to the land where they would die, or if they are permitted to pass through the turbines of power plants where they would be killed, the future supply of salmon in that particular river would be destroyed. To prevent such destruction fish screens are used. Experience has shown that the largest canals can be screened without decreasing the flow of water.

The work of fish screen installation



Courtesy California Fish and Game Commission

Sometimes it is necessary to zig-zag the fish ladder up the incline around the end of a dam as shown in this illustration. Overflow from dam shows at the left

Ineffective screening of an irrigation ditch was responsible for this loss in fish life

in California is carried out under provisions of the Penal Code which, in general, state that when, in the judgment and opinion of the Fish and Game Commission, a fish screen is required to be installed in a ditch, tailrace, or a tunnel, the Commission may order one built, specifying location, type, size, and, in fact, all the details which are necessary for its construction.

Two general types of screen installation are used in California, namely, the rotary, self-propelled type, and the stationary, parallel bar type. The rotary type consists of a steel shaft to which there is attached a circular frame which supports mesh of one-half inch by six inches, with boards or paddles set on the inside which furnish the motive power for its rotation. This screen is set in a box of supports for the entire width to be screened. To pass the trash that may come down, or to remove the moss, it is set up from four to eight inches from the bottom of the ditch and this space is protected by a board set on hinges, fastened to the bottom of the ditch and connected by rods to a spring, so that when the pressure of the trash becomes more than the tension of the spring, the board, or draper, will drop down sufficiently to pass this trash and then come back into place. On the top of this board is a section of canvas or rubber belting which lightly touches the wheel as it rotates and thus removes leaves and moss from the rotating screen.

THIS general type is used because it is not patented, and while there are patented screens that may be better, yet it is not policy for the Fish and Game Commission to order in a patented screen unless the diverter of water so desires it.

Among successful fish screens devised by various individual inventors is a self-cleaning fish screen, a recent invention of Francis Cuttle of Riverside, California. Originally designed for the removal of trash from canals it is also an effective fish screen. Its motive power is derived from a current water wheel and as its mechanism is geared to run slowly, it has great power. This enables the machine to remove with ease large objects from the stream in which it operates. Under test with two men on the teeth that lift the trash from the water and with others on the crossbars, the machine has handled the extra weight without any appreciable lowering of its speed. This type meets most of the objections against their installation held by diverters of water.

The upright rack for catching the trash consists of steel bars, bent on a curve at the upper end, and held in place to a cross bar at the upper and lower ends. The teeth for removing the trash are attached to a shaft which, in turn, is attached to sprocket chains actuated by a shaft attached to a spur shaft driven by the water wheel. Spacing of the bars may be arranged as required. The trash is deposited on a cross-carrier by the teeth which are then withdrawn by an upset arrangement at each end. The teeth disappear under the bar to reappear at the bottom on the next round. The carrier deposits all debris at one side of the canal.

Naturally the length of the bars and width of rack of the water wheel will vary with different canals, but the gears, teeth, upset devices, and in fact, everything but the length of the bars and width of the water wheel will be of one design. The speed is regulated by the size of the sprocket wheels on the shaft of the water wheel and the spur shaft. Usually this speed is about one complete revolution of the teeth every two minutes but this may be varied at will. As the speed is very slow, the working parts will wear but little.

The usual stationary parallel bar screens used in California are built in sections and placed at an angle to the direction of the flow—the greater the angle the better. These stationary parallel bar screens are a refinement of what is commonly known as a grizzly, or rack. There are variations of this type of screen in that some are made to rotate, and some have a self-cleaning device, such as the Cuttle device just described, the power being furnished either by the water itself or by a motor. For these bars the spacing is seldom less than ½-inch and when placed properly in the stream offer no appreciable interference with the flow of water.

The stationary type of screen is, in general, considerably cheaper to install, in proportion to the area to be screened, than the rotary type, and is more commonly used for the larger ditches, while the rotary screen is considered more suitable for small ditches.

A VERY effective self-cleaning screen rack has been in use at the Empire Gold Mine in California for many years, which can also be used as an effective fish screen. This device was home-made and is shown in one of the accompanying photos. The trash rack, or grizzly, is spaced to stop trash and fish and the automatic trash cleaning device consists of a series of bars which are fastened to sprocket chains which are driven by an undershot water wheel.

Self-cleaning fish screen devised by Mr. Cuttle. Trash on the rack is about to be discharged on to the cross carrier

The effective self-cleaning fish screen which has been in successful operation for years at the Empire Gold Mine

FLYING TO FIND OIL

By MILTON WRIGHT

"FRANK HAWKS and I were flying low—just about a hundred feet up—examining the ground for rock strata that might give a clue to a likely place to sink an oil well, when suddenly we heard a burst of sound that reminded us of the old days in the War. Crack! Crack! Crack! There must have been twenty repeating rifles pumping away at us from the woods. How we longed for a good 112-pound bomb to drop on them. We couldn't charge them, for they were protected by the trees. The only thing for us was to head back for Tampico. We reported the attack, a company of soldiers was sent out to the place we described, and we understand quite a pretty little battle followed with half a dozen bandits and eight or nine soldiers being killed. We didn't see the fight, however; we were more interested in our job of helping to find oil lands."

IT was Lieutenant Robert Alfred Smith speaking, killing time as he waited for the regular weekly get-together of the famous organization of Quiet Birdmen of which he is a member. Smith, who happens to be chief of the Oblique Division of Fairchild Aerial Surveys, has spent more time in the air making oblique pictures than any man who ever flew. He probably also has made more maps from the air than any man living, but he hesitates to admit it. He thinks it just possible that there may be one or two fellows in the army who have done more map making than he has. Altogether he has more than 2000 flying hours to his credit, 1000 of them with a camera.

"But why did these Mexicans start shooting at you?" we wanted to know. "Did they take you for Federal soldiers scouting their position, or did they think you were carrying a payroll they could rob you of?"

"No," he replied. "They were just trying to raise a little hell. Mexican bandits are like that. Just as a small boy will throw a stone at a bird, one of these chaps will throw his rifle butt to his shoulder and blaze away at any airplane that happens to fly within his range. There is nothing personal about it, you know; they merely are trying out their marksmanship with a moving target. Once I was flying over what I thought might be a new oil field, minding my own business, when a man on horseback began firing at me. Fortunately, it was nice open country, with no trees about, so I was able to swing around and aim my plane directly at him. If he hadn't tumbled from his horse and lain flat on the ground in the nick of time, I'd have got him. The few shots he sent after me didn't worry me. He was entitled to them after the fright I had given him."

"But how do you locate oil from the air?" we queried.

Lieutenant Smith has probably made more maps from the air than anyone else in the business today

"With a camera. Of course, I don't pretend to be a geologist; to know the air and the ground is about all that ought to be expected of one small head, without having to know what's under the ground, too. But making maps for oil companies, as we do, we get to know quite a bit about oil-bearing indications.

"Here's the way it works. An oil company has a vast area in which it hopes to strike oil at some point. I go up in a plane, sitting in the back with an aerial camera. The first thing to do is map the ground on a small scale. This we do from a height of about four miles. We fly along one edge of the area to be mapped, taking vertical snapshots as we go. When we reach the end of the track we fly back again a little farther in. Then we double back again, and so on, hour after hour and sometimes day after day, until we have covered every foot of the ground. I've covered as much as two thousand square miles in a day. This was flying at an altitude of 16,000 feet.

"Now we come down and develop our pictures. Each one overlaps the one beside it by 50 percent and the one in front and behind it by 60 percent. We cut the developed prints and put them together, making a mosaic. We look at the prints through a stereoscope.

"You remember the stereoscope that nearly every home used to have for the benefit of the children? You put two views of the same scene in the wire frame at the back and looked through two pieces of glass and saw the view in three dimensions, the trees and rocks and houses standing out in bold relief. That's exactly the way the geologist's stereoscope works. He sees the contours of the whole landscape, here the rocks jutting up, there the tall trees, there a deep ravine or a shallow one. Especially is the geologist interested in river beds, extinct river beds even more than present ones, and in hill crests.

"WE pick out a certain sector that seems most likely and map that on a larger scale. Then we go over the larger maps and the geologist goes in with ground guides to look for suitable outcroppings. The geologist notes the slope downward of the rock strata here and its upward slope farther along. By skillful calculation he estimates where the crown or lowest point is. If there is a pool of oil to be found, it will be in the vicinity of the crown. The spot determined, down goes the boring and up comes the oil—maybe. Sometimes she gushes only salt water."

"How much oil land can you show with one exposure of your camera?"

"As much as you want. It depends upon how high you fly. Suppose you want a map on a scale of 800 feet to the inch, and the lens of your camera is 12 inches from the negative. You multiply 800 by 12 and get 9600. That's the height you fly at—9600 feet. Simple, isn't it? Just multiply the scale you want by the distance from lens to film and you get the height you have to fly."

"How frequently do you have to snap your pictures?"

"That's something you can't calculate until you are up. It depends upon both the height and the wind velocity. Generally we use a view finder to determine how much we are drifting. Flying at a fair rate of speed I should say that you would have to expose your film about every thirty seconds or so. But the wind has a lot to do with it. I have found myself flying with all the power I had directly in the teeth of the wind and actually drifting backwards. This meant that the wind was blowing against me at a speed of well over a hundred miles an hour."

Getting into his present work was more or less of an accident with Smith. He served with the Royal Flying Corps in France until 1917. In 1918 he served as army instructor in the British Isles, specializing in air photography. When the war was over he was sent to Camp Borden to teach in the Royal Canadian Air Force. Completing his tour of duty in 1922, he started back to England, but stopped off in New York to see the sights. By way of paying a social call, he dropped in at the office of Fairchild Aerial Surveys.

"YOU'RE just the man we're looking for," they cried, welcoming him with open arms. "We're commissioned to make a map of the city of Newark. Stay over a few days and do it for us."

"That's the way it started," Smith told us. "When I had the Newark job finished there was a big tract of oil land to be surveyed. It would only be a week or so. Then there were some mining properties in the northwest. And so it has been going. What with one flying job crowding on the heels of another, I found myself flying every day and I haven't made that trip to England yet. This flying business certainly keeps a man busy. When Commander Byrd was making his plans for the South Pole expedition, I completed arrangements to go with him to do all the air photography. There was so much work to be done up here in North America, however, surveying oil lands, timber tracts, mining properties, real estate developments and what not, that I had to call it off."

"Do oil companies use planes to any great extent?" we asked.

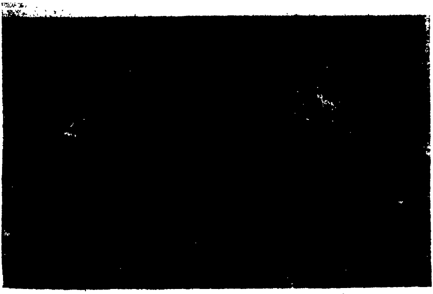
"Sure. They use planes not only to locate the place to drill and to take in supplies while construction work is going on, but after the wells are in operation they transport the payrolls by air. A large part of the work of the Compania Mexicana de Aviacion, for example, is done for the oil companies. The payroll boys often have some hard flying to do. To get to Mexico City, for illustration, you have to fly over an eleven thousand foot mountain range. Generally, I've had to climb up through the clouds to get there. The payroll is usually delivered by dropping the sack containing it in a marked circle on the ground; thus the pilot does not have to land. One time one of the military guards at a camp tried to catch the sack. He was of no more use to the army for three months.

"There is an element of danger, too, in carrying payrolls of oil companies in Mexico. One day one of the pilots flying to a camp with the payroll saw the circle on the ground and a group of armed men standing about. He was going to land, for his engine wasn't running as smoothly as he could wish, when one of the men took a shot at him. He swooped up again and streaked back to Tampico. A group of bandits had driven off the soldiers and were waiting for the payroll. That happens every once in a while.

"Such things, of course, don't occur every day. What bothers us more than anything else in oil development work are clouds and winds. To make a survey on a large scale you have to fly pretty high. It is a fact not generally known that no matter how hard the wind is blowing down near the ground, it is always blowing west above 15,000 feet, and it blows hard; sometimes its speed is over a hundred miles an hour.

[illegible] Fairchild Aerial Camera Corp.

The stereoscope supplies the "third dimension," bringing out contours


An aerial view of typical oil country. The outcroppings that show encourage the geologist to study farther. A boring is being made in the lower right corner

"The only days we can make surveys are days when cumulus clouds—those high, piled up, puffy ones—are not in the air. Cumulus clouds float along at a height of 5000 feet. Sometimes you can see thunder storms rising up from the clouds to a height of 13,000 or 14,000 feet. At such a time you weave your way in and out between the storms. Such storms, you know, don't start operations until they are 13,000 to 15,000 feet up.

"In surveys we have two kinds of difficulty resulting from cumulus clouds. The clouds pass between your ship and the ground when you are making large scale maps, and, of course, you can't see through the clouds. On the other hand, when you are making oblique pictures the clouds cast shadows on the ground that show up in your pictures and are likely to obscure the very rock formation you are most anxious to study.

"CLOUDS and wind, however, in spite of the trouble they sometimes cause us, are very helpful indeed. They tell us just what conditions to expect in the air. We know that a wind from the northwest will bring a fine day, generally with the cumulus clouds that mean ideal survey weather—after they have cleared. A wind from the north will bring a fine day, generally without clouds. A wind from the southwest will bring thunder storms with cumulus clouds, especially in the summer time. Winds from the east usually bring rain in most parts of the United States."

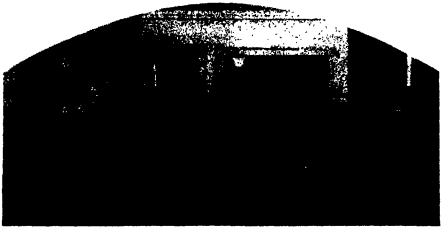
"And where do you get your biggest thrill in all this survey work?"

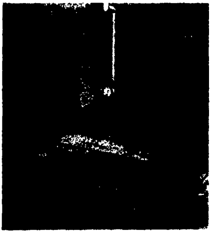
"The biggest thrill lies in getting a job well done. You fly over an area that is practically unknown. This incident or that comes up, but your mind is set on getting an accurate picture of the terrain that will show you oil indications. You develop your prints and piece them together. You see promising rock strata. There is your thrill."

SAFEGUARDING SOCIETY

By ALBERT A. HOPKINS

BACK of the orderly processes of law as we generally know them, stands an agency more powerful than this law, though it is a part thereof. Be a man politically powerful, wealthy, of highest social standing or be he a poor bum in the street, if he dies under suspicious or not readily explainable circumstances, the coroner must be notified before the body can be touched. In this particular the coroner has authority over every other branch of civic government. If the situation warrants it, the body is removed to the morgue, the protective features and social importance of which are so little understood or, as is often the case, so greatly misunderstood.





Above: This looks more like a hotel office than the entrance to a morgue

Right: The person is transferred, in private, from the police wagon to truck

The coroner's office is an ancient one; in olden times the one holding it was a local agent of the king and had many duties to perform other than those relating to deaths. Now, however, with the progress of civilization the problems of sudden death have become complicated and it requires many of the resources of science to help solve them. It is to the interest of the family as well as to the state that a reasonable investigation of death is made where there may be involved a question of reputation, of property, of insurance, of personal satisfaction. In many cases there are in the offing suspicions of crime.

The enclosed yard is like a garage and can accommodate many vehicles

The writer recently paid a visit to Philadelphia, Pennsylvania, to see the remarkable work done by Dr. W. S. Wadsworth, who is the author of the standard work on post mortems, and who is an authority on the construction of morgues. Now at last he has been able to build a structure that embodies ideas gained through years of experience. Asked as to "why a morgue?"

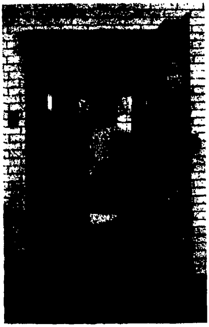
Where the public can view unknown persons who rest on inclined slabs in a refrigerated chamber. Only interested persons may gain access to this room

Dr. Wadsworth responded as follows:

"In every large city there are many sudden deaths. A limited number of these are clear cases of collapse of a vital organ—most often the heart—but some are not clear at the time and may not become so after a careful study of the person's past. The rapid increase of death by street traffic has greatly enlarged the number of investigations. Travelers form a considerable part of this problem. Of course, many cases are rushed to the hospitals but few of these have facilities or personnel for what follows. Some cases can be cleared up very quickly; but where the persons are unknown, or strangers, or where the conditions must be studied to see whether there are any grounds for suspicion, or where a crime is evident, there must be a delay and most large cities have found it not only desirable but necessary to provide a centrally located place for the reception and care of such cases.

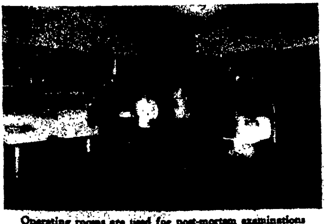
"These places are generally called 'morgues.' The term is somewhat harsh sound and has gathered to [illegible] n savory reputation. The [illegible] ll [illegible] i the memory of those living when here was hardly a respectable morgue n the country. Indeed, hospital mortua·ies and the average undertaker's quar·ers were equally bad, but these showed mprovement before any could be noted n the municipal establishments. It has been only within the last few years that the large cities have awakened to the [illegible] of providing suitable establish[illegible] or this work. This awakening has spread rapidly. While Philadelphia was not the first in the field, the machinery was started some years ago and the preparation of plans and the construction occupied several years. So much care was exercised throughout that we deem the result of general interest. Before developing the plan certain ideals were outlined. Every case was to be treated in such a way that the nearest friend and closest relative would have no added pain."

Above: Showing receiving method of transfer from the ward carriage to the crypts. Note the metal trays on floor. *Right:* Crypts and scale



The "zero room" is separated from the crypts by an isolating air lock

THERE is nothing about the Philadelphia morgue to suggest its purpose; it might well be a building devoted to any welfare purposes. The visitor enters the door, and finds himself in a room somewhat resembling the office of a small hotel. Here visitors and those having business to transact make known their desires. The day of the morgue as an attraction for the curious has passed away all over the world. If the visitor's purpose is to identify a friend or relative and no record is on file, the visitor is taken down a hall, which is



Operating rooms are used for post-mortem examinations and investigations. Every room is individually ventilated

The X-ray room is elaborately equipped to make X-ray pictures which are valuable in many medico-legal c

The analysis of color is carried on in a special laboratory which contains novel pieces of apparatus and charts. Color of organs is best tested with color screens

really an air-lock, and is permitted to view the unidentified bodies which rest on modern sanitary slabs. This chamber, like all the others for preserving the dead, is refrigerated, there being two refrigerating plants in the basement.

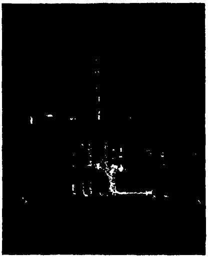
Dr. Wadsworth spent much time in designing the rear block or storage section so that it would be simple, sanitary, cleanable, thoroughly ventilated, well lighted, free from insects and what he calls all sorts of "architectural jokers." The construction of the individual crypts required the co-operation of the manufacturers, contractors, architects, and those in charge of the planning, since no similar structure was available as a model. Directly on arrival in the large yard, cases are placed on wheel stretchers and sent immediately into a cold chamber where ample provision is made for disinfecting and preserving clothing.

Photographing a subject is rendered easy by the vertical camera

THE ventilation is by individual fans with separate flues in each room. There are 10 of these and they can be put in operation when and where needed. The central hall with skylight ventilator is actually an airlock so that no sound or odor can reach the front portion of the building. Off this open the X-ray and the photographic laboratory where photographs can be made by various arrangements of the camera. There are also operating rooms where important medico-legal work is carried on, for the question of color of an organ or tissue is often very valuable and, with a set of standard colors which is to be found here, any one of these can be accurately analyzed.

Access to the chemical laboratory is also gained from this hall. When it comes to cases of poisoning, the skilled toxicologist is able to render most valuable aid. Dr. Wadsworth has one of the finest card catalogues in the world relating to cases of poisoning.

In some cities, in New York for example, ballistic work is done under the direction of police officers, but the net result is the same whether done by a coroner's physician or by a detective, assuming the same technical skill in each instance. Dr. Wadsworth's firearms laboratory is magnificently equipped with comparison microscopes, binocular microscopes, and a complete photo-micrographic outfit. In the basement is a range for testing firearms. One of our illustrations shows the doctor himself firing a bullet at a cotton target so that the tell-tale marks will not be effaced. Then the bullet from the suspected gun may be compared in the laboratory with a fatal bullet. Of course the cartridge shell often gives as valuable evidence as does the bullet. (See the SCIENTIFIC AMERICAN for October and December, 1930. *Editor.*)



Finding the specific gravity of organs by weighing in air and water

It has remained for estheticism to place the morgue, conceived and developed as a bulwark of society, on the high plane of our best hospital service, as indeed they rank equally high i importance to the community.

Dr. Wadsworth making revolver tests in the rifle range in basement. *Note effects of powder recorded on screen*

kinds for use in fatal and test bullet and shell comparison

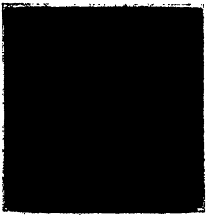
FROM THE ARCHEOLOGIST'S NOTE BOOK

A "Melian" Terra-cotta Relief

THE Museum has just acquired one of the rare so-called "Melian" terra-cotta reliefs (some are said to have been found at Melos) of the first half of the 5th Century, B.C. It is only 7⅜ inches high and the width of the plinth is practically 11 inches. The subject represents the "Return of Odysseus." To the right is Odysseus, scantily clothed in the guise of a beggar leaning on his stick. He is grasping the arm of his wife Penelope who does not recognize him. She is in the attitude of mourning. Behind her is her son Telemachos, starting back in surprise at the sight of his father. The whole epic of the return of Odysseus to his home is thus brought before us, not in any one particular incident as told in the "Odyssey," but in Greek fashion as an integral whole.

Ink Tablets Afford Plastic Medium

THOSE who prefer Chinese ink rather than the liquid article often feel keen regret at having to spoil the exquisitely engraved sticks or tablets by rubbing them up with water on a slab. While a liquid ink is primarily the problem of the chemist, an ink in solid form becomes, after the manufacturing process has been perfected, a plastic medium of importance to the designer and engraver. The best engravers in China were commissioned to make the molds. Some of the cakes and sticks were not intended to be made into liquid ink and were so marked. The various themes include practically everything that is likely to interest the Chinese scholar. The book of designs of two of the most famous makers are veritable cyclopedias of Chinese art themes. The Museum has just acquired 64 pieces. Some of the examples show palaces which have been destroyed.



Chinese ink tablets afford a plastic medium of use to the designer

The Remodeling of Rome

PROBABLY the enthusiastic archeologist would like to see all Rome excavated. He is getting his wish only in spots but these spots are all important. Rome, however, is a forward looking city teeming with life and must have improvements. Fortunately, modern traffic problems have become so acute and the older parts of the city have become so congested and unsanitary that a drastic overhaul was necessary, involving a great system of town planning. New streets are being laid out or broadened, slums have been wiped out, and all these activities have been carried on with due respect for archeological interests. The Mussolini government is greatly to be commended for backing archeological exploration so splendidly in Rome, Pompeii, Herculaneum, and Ostia.

All photos courtesy Metropolitan Museum of Art

A terra-cotta relief, Fifth Century, B.C., shows the return of Odysseus

A beautiful Greek head of warm yellow Pentelic marble from a gravestone—end of Fifth Century B.C.

Head from Greek Gravestone

AT the recent sale of the Lansdowne Collection in London the Metropolitan Museum of Art acquired the famous Lansdowne stele. It is a fragment of a Greek gravestone with the head of a woman and the upper portion of the pediment, the head practically life size and in excellent preservation. It belonged to a great monument of the Phidian school. It teaches us better than many words what we mean by Greek idealism, the serene beauty which, to the Greeks of the 5th Century, B.C., constituted the aim in art. The effect of idealization is obtained not only by the selection of a noble type but by the large, simple modeling. The work is free from the expressive distortions of modern art; the Greeks idealized nature, but did not transgress it. Frequent wettings were required to remove the London soot with which the surface was coated, revealing the warm yellow Pentelic marble. The fragment has had a long history having been mentioned as far back as 1837. It was shown in London in 1904 in the memorable exhibition of Greek art.

An ancient Egyptian "vanity" box has eight compartments for ointment vases and space for the mirror

"LARGEST METEORITE SEEN TO FALL"

By **CHARLES CLAYTON WYLIE**
Associate Professor of Astronomy, University of Iowa

AT about 4:08 A.M. on the morning of February 17, 1930 a brilliant meteor appeared over southern Indiana, first attracting attention when nearly in the zenith for persons living near Evansville. It fell to the southwest, following approximately the direction of the Ohio River, crossed southeastern Missouri, and at a height of about ten miles, near Paragould, Arkansas, it burst into three main pieces. The velocity of these smaller pieces was checked rapidly by the dense lower atmosphere, and the brightness diminished so that the largest piece became invisible at a height of about five miles. The bursting and disappearance of the meteor, as seen from a distance of 75 miles, was similar to the bursting of a big rocket, and so was the disappearance of the sparks.

Following the disappearance of these "sparks," the larger stones continued their fall as dark bodies, two at least reaching the earth as meteorites. One, whose weight was determined as 820 pounds, went down in clay soil a little more than eight feet, and is the largest meteorite for which the date of fall is known. A second stone, weighing about 80 pounds, was also recovered.

THE brilliancy of the meteor is indicated by the fact that, in the vicinity of St. Louis, Missouri, several persons mistook it for an airplane going down in flames, and a night garage superintendent sent his service man to the park to investigate. At the hour of the fall nearly everyone was asleep, but in the vicinity of Paragould practically all were awakened by the detonations and some were awakened from sound sleep in southern Missouri and eastern Tennessee.

Because of the importance of this meteoric fall, observers of the meteor in the three states, Arkansas, Missouri, and Tennessee, have been personally interviewed by the writer, and information from more distant points has been obtained by correspondence. At the time the meteor appeared, two young men from Beech Grove, Arkansas, were going fishing, driving in a wagon. The landscape lighted up, it seemed brighter than day, and looking up they saw a ball of fire come out of the northeast, pass overhead, and disappear at an altitude of about 20° in the southwest. Their impression was that it had burned out and dropped in the field to their right. The team was accustomed to bright automobile lights, and went on without change of pace for about a hundred yards, when a blast as though from an explosion of dynamite frightened both men and horses. The first sharp explosion, which seemed to come from about where the meteor had disappeared, was followed by a roar as though a great tornado was retreating along the path of the meteor. The noise crashed back to overhead in "no time," and on to the northeast more slowly, fading out in the distance in the direction from which the meteor came. At first, the young men were ready to call off the fishing trip and go back home; but when they had quieted the horses and talked things over they decided to go on.

The author and the hole from which the big meteorite was recovered

At Poplar Bluff, Missouri, the night man in charge of the freight yards had just made up a train, when he noticed a brilliant light, like the headlight of a locomotive, moving in the eastern sky. It crossed to the south, burst into three pieces and disappeared. He examined its trail a moment, then walked over to the telephone booth to report his train. He had called up his party, and was talking, when the report of an explosion startled him. His first thought was that something had crashed into the train he had just made up, with perhaps a boiler explosion, so he rushed out of the phone booth, but when outside realized the noise must have come from the meteor.

It is interesting to compare the facts obtained for this meteor with the observations and conclusions of men of science from other well investigated falls, since several of these points are not well known by the educated public in general.

First, two large meteorites were recovered, and there are indications of a third good-sized stone which was not found. A great meteor may scatter stones over an area ten miles long by three miles wide. Much of this area will normally consist of fields, wooded lands, and, in general, country where people will not often be walking. A meteorite weighing a pound or more will normally make a hole deep enough below the surface of the ground, so that it will be unnoticed unless someone happens to pass almost over it. In a field of grain or hay, or in underbrush it might be passed by, even then. The big Paragould meteorite made a hole more than eight feet deep and scattered clods of clay more than 50 yards, in a pasture, but this crater was not noticed for four weeks. By that time a smaller hole would have been filled up by rains, so that in all probability a person would have passed it by.

UNDOUBTEDLY many stones are noticed, or even picked up, which do not find their way into the hands of scientists. Near Paragould we showed a specimen of meteorite to those whom we interviewed. One farmer told us that he had noticed in his pasture a small stone of that appearance, but he had not picked it up. As he was interviewed more than a month after the fall and remembered only approximately where he had seen it, there was no way of ascertaining whether or not he had really seen a small meteorite. Another farmer told us that immediately after the fall of the meteor he had noticed in his pasture a hole which, from his description, was such as a 50-pound stone might have made in striking. He had looked in it and, as he noticed nothing, filled it up.

In investigating another report of a meteoric fall, we were told that a fresh hole with a stone at the bottom had been located in a field, and that the finders planned to dig up the stone, but the owner of the land would not permit it. Instead he filled up over the stone, and then plowed the field so that no one could locate the place.

These reports probably do not all refer to authentic meteorites, but undoubtedly they illustrate the fate of many which are genuine.

THE ball-of-fire appearance for the Paragould meteor previously mentioned ended at an altitude of five miles and the first meteorite recovered was reported "not hot" when dug up. Von Niessl found 14 miles as the average height of disappearance for 16 meteors from which meteorites were recovered. Since the Paragould meteor furnished us the largest meteorite for which we know the circumstances of fall, we would expect the height of disappearance to be less than that for an average meteoric fall. The assumption of the educated public undoubtedly is that, since a meteor is seen in the upper atmosphere as a ball of fire, any meteorites which fall should also reach the earth as balls of fire. This general impression appeared in a newspaper feature on the Paragould meteor. It was stated that a ball of fire was seen by certain persons to strike the earth in a field, and that when morning came they went to the field and found a hole with a strange looking stone at the bottom. But we know that these people did not see the meteor at all, and from those who did see it we can calculate that it disappeared at a height of five miles.

The direction of fall of the big stone was nearly vertical, the deviation from vertical being indicated by the angle of the hole—about one foot for a hole slightly more than eight feet in depth. The first report on the 80-pound stone was that it had entered the ground at rather a low angle from the southwest. This was the report of the two men who removed the stone from the hole. A competent civil engineer who examined the hole soon after the removal of the stone reported to us that he doubted the accuracy of this first report. From such markings as he could find he suspected that the stone had actually fallen from the northeast, that the dirt had fallen into the hole from the southwest, so that the stone was found to the northeastern side of the hole which the farmer found.

From theoretical considerations it has been computed that whatever the original direction, and whatever the original velocity of a meteor, meteorites near the surface of the earth should fall in an almost vertical direction and with a velocity not greatly in excess of that at which the resistance of the air is balanced by the pull of gravity on the meteorite. It has been observed that stones large enough to make a deep hole fall almost vertically. For example, at Tilden, Illinois, a stone weighing 110 pounds and going down into the earth three feet ten inches deviated six inches from the vertical in that distance. There are several reports of smaller stones striking at a low angle and bouncing a short distance. A seven pound stone falling at Amana was reported to have bounced 30 feet.

In view of the fact that a seemingly very positive report of a stone striking at a low angle was questioned by the first careful investigator examining the hole, it appears that such reports should have complete confirmation before we consider them established. In this instance it appears highly improbable that an 800-pound stone should strike almost vertically, with a slight deviation towards the southwest, and that an 80-pound stone should be thrown back at a low angle toward the northeast. Meteorites contain no explosives and observations indicate that after the bursting the smaller stones fall in a more vertical direction than the larger stones.

The larger stone was found about two miles farther in the direction of travel of the meteor than the smaller stone. This agrees with the facts collected wherever the direction of the travel of the meteor is definitely known. After bursting, the smaller stones fall quite directly to the surface of the earth, while the larger stones can overcome the resistance of the air better and travel a few miles farther before striking the earth.

The largest meteorite seen to fall, the Paragould meteorite, now on exhibit in the Field Museum

The sound of the explosion appeared to come from about the place where the meteor disappeared, and the roar that followed traveled back along the path of the meteor. This effect has also been reported wherever we have the complete information. Meteors travel with a velocity greatly in excess of that of sound and, as the point of bursting is nearer than other parts of the path to those near the point of fall, the explosion is heard first and the roar of the meteor along the more distant portions of its path follows.

The Paragould meteor gave everyone the impression of being very close. At St. Louis, Missouri, as we have said, several thought it was an airplane going down in flames. At Topeka, Kansas, an engineer wired back to Burlingame asking that they look for an airplane which he thought had gone down near that town. At Poplar Bluffs, Missouri, the father of a sick child returning from a doctor's office thought the ball of fire coming out of the east was going to strike him and ran to get out of the way. This is the impression whenever a bright meteor falls. People three or four hundred miles apart will each believe that the meteor has fallen within a mile of their point of observation. For example, several persons in Nebraska thought that the meteor of July 25, 1929, which burst nearly over DeKalb, Illinois, had fallen within a mile of them, and at Williams Bay, Wisconsin, astronomers of long experience felt an impulse to dodge when they saw the brilliant ball.

THE big Paragould meteorite is now on display at the Field Museum in Chicago, as "The largest meteorite seen to fall." We put the museum authorities in touch with the original owner, but it was some time before they succeeded in purchasing the big stone. We were told that it was weighed on good scales as 820 pounds when first removed from the hole. Before it reached the Field Museum a certain amount of it was knocked off at one place, and at that institution its weight was determined as 745 pounds.

Previous to the fall of the Paragould meteor the largest meteorite seen to fall was the 650-pound stone which fell near Knyahinya, Czechoslovakia, on June 9, 1866. The largest stone meteorite known, weighing more than 1200 pounds, fell near Long Island, Kansas. It was broken by striking on a ledge of rock. The date of fall is not known. The largest meteorite now known is an iron one which lies where it fell at Grootfontein, South Africa. (Three photographs of this meteorite were published in SCIENTIFIC AMERICAN, October 1929—*Ed.*) Luyten, of Harvard, visited the locality, and estimated its weight as 50 tons or more. A few other prehistoric masses of iron, accepted as meteoric because of their structure, are much larger than any meteorites for which we know the date and circumstances of fall.

●

A more recent "meteorite," widely noticed in the press, is possibly a fake, and an able authority has promised a discussion of it.—The Editor.

The segregation pool in the core trench of the dam. Trains dumped their loads of earth down the side banks; and powerful pumps on several scows shot streams of water on this loose material, washed it down, and settled it firmly

THE MAMMOTH SALUDA DAM

ON the Saluda River, 10 miles from Columbia, South Carolina, in the Saluda River Hydro-Electric Development is the largest earth dam for electric power purposes in the world. The dam is 208 feet high, nearly a mile and a half long, a quarter of a mile thick at its base and contains 11,000,000 cubic yards of material. The crest is 25 feet wide. It forms a lake which is 41 miles long, 14 miles wide at its widest point, covers approximately 76 square miles of land, and has a shore line of 520 miles. In water holding capacity it is the third largest in the country—93,000,000,000 cubic feet—being surpassed only by the Gouin development, St. Maurice River, Quebec, with a capacity of 160,000,000,000 cubic feet and by Elephant Butte, New Mexico, which has a capacity of 114,911,000,000 cubic feet.

Field work was started in April 1927 and the plant was completed and placed in operation in October, 1930. The installed capacity is 140,000 kilowatts, which will later be increased to 200,000 kilowatts ultimate capacity.

The general scheme of development called for first laying on bed rock, parallel to the river, four penstocks 15 feet in diameter and one concrete arch conduit approximately semi-circular in cross-section, and 48 feet in diameter inside. The penstocks are of plate steel and are completely encased in concrete having a maximum thickness of about four feet. The earth dam was then placed on top of these conduits and they served to take care of the river flow during construction. As the dam progressed and the penstocks were no longer needed for the above purpose, work on the power house was started and the pipes extended to connect with the turbines. The 48-foot arch conduit was continued in use as a by-pass for the water, when necessary, until the work reached a stage where surplus flow could be passed over the regular spillway. This spillway is not a part of the dam proper, but is located on the south bank on bed rock and discharges into an adjoining creek bed.

FOUR concrete intake towers with steel reinforcing, each 30 feet in diameter and 223 feet high, serve the penstocks. A fifth tower, 60 feet outside diameter and 223 feet high, serves the concrete arch conduit and provides for two additional steel penstocks.

At the bottom of each of the smaller intake towers, on the upstream side, are installed trash racks 75 feet high. Inside the racks on the center line of the tower are a pair of Broome roller gates for cutting off the flow of water to the penstock. Each pair of gates is operated by a 234-ton hoist, capable of lifting them with the pressure unbalanced, although as a precaution, a by-pass has been provided for first filling the penstock. The hoist is installed in a brick building on top of the tower.

In the larger tower, which is designed to serve two future penstocks, six gates of similar construction have been placed in openings around its periphery about 100 feet above the base of the tower.

The trash racks around this tower extend upwards 70 feet from the bottom of the gates. Each gate is operated by a 40-ton hoist connected electrically to the hoist diametrically opposite to it.

All the gates can be operated from the power house through remote control. Access to the hoists is by means of a passenger cableway several hundred feet long from the dam to the large tower.

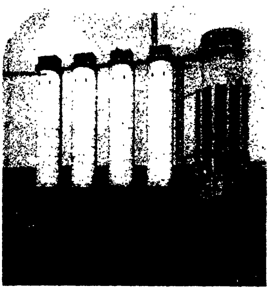
The dam was built in three sections. The upstream and downstream sections were first built across the river bed and valley, like two parallel dams, from hill to hill, a distance of about 1000 feet, then raised until they were about 75 feet high and widened until within about 500 feet of each other. The area between them was then stripped of all sod and loam, and all loose material was removed from the exposed river bed. A core trench was next excavated midway between the two fills and parallel to them about 50 feet wide and 10 feet down to ledge rock or to other impervious material.

At this stage, the area of the basin between the two fills was pumped full of water to a maximum depth of 25 to 30 feet. The pool so created was known as the "segregation pool." This pool was thereafter maintained by pumping in enough water to take care of evaporation and seepage. On the pool were launched five scows, on each of which was mounted pumping equipment for taking water from the pool to supply a giant nozzle or monitor, discharging 750 gallons of water per minute at a velocity of 125 feet per second. The streams from these monitors were directed against the banks of the earth fills, washing down the fine material into the pool, where it was deposited to form a dense heart or core for the dam. The work was carried out in such a manner that the middle sixth of the completed dam is composed of densely compacted material, of which at least 65 percent would pass a 100 mesh-per-inch screen.

s the bottom of the pool filled up with fine material the outer earth fill were raised by dumping additio loose earth, the space between these fill rrowing as they went higher, s the general outline of the section of the completed dam was followed. When within 30 feet of the top these sluicing operations stopped as the pool became too small for the operations.

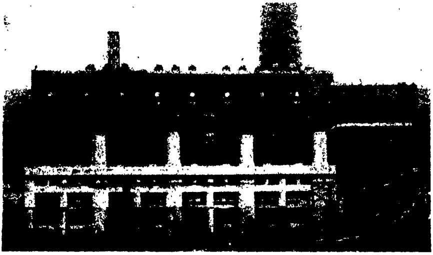
The next section of 10 feet was built by dumping selected materials into the pool. The last 20 feet was built by consolidating selected materials by wetting and rolling, as was also that portion of the core that extended more than 110 feet about the original ground. The maximum width of the core is approximately 350 feet.

The upstream face of the dam from the crest downwards 67 feet was covered with rip-rap varying uniformly in thickne to the face of the dam, fro one foot at the lower edge o feet at the top. This rap was composed of either one-man stone or gravel, or a combination of both. On the downstream face of the dam there was planted 100 acres of Bermuda grass to protect the face against future erosion.

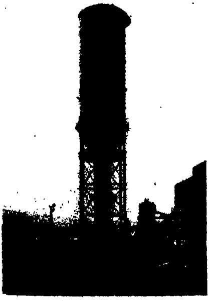


Photographs courtesy W. S. Barstow and Company, Inc.

The four concrete towers that serve the penstocks, and the larger one for the arch conduit



The tailrace of the Saluda power plant shortly before its completion



One of the surge tanks which make possible speed regulation of units

A spillway, equipped with four Tainter gates, each 37 feet 6 inches wide and 25 feet high, was placed across a gully 500 feet from the south side of the dam. The discharge from the spillway enters the river channel about three quarters of a mile below the power house. The spillway can take care of 150,000 cubic feet per second. Under extreme flood conditions the level of the lake will rise no higher than to within seven feet of the crest of the dam.

Two surge tanks, 38 feet in diameter and 219 feet in overall height, each having a capacity of about 800,000 gallons of water were erected adjoining the power station to enable speed regulation to be maintained on two of the units. The other two units will not be equipped with surge tanks unless experience shows them to be required.

The penstocks connect to 16-foot diameter, motor operated, butterfly valves at the power house. Each valve has a 24 inch by-pass pipe and motor-operated gate valve which will be used to equalize the pressures on the two sides of the butterfly valve before opening it.

THE turbines are of the vertical shaft, Francis type, each developing 55,650 horsepower at full gate at 180 feet net head rotating at 138.5 revolutions per minute. The scroll cases are of plate steel, and the draft tube is an elbow type tube, with a long horizontal. Each generator has a capacity of 40,625 kilowatts at 0.8 power factor, is wound for 13,800 volts, 3 phase, 60 cycle current, and is equipped with a 250-kilowatt direct-connected exciter and a 35-kilowatt pilot exciter. The generators are of the single bearing, overhung rotor type, having a thrust and steady bearing in the same oil pot beneath the rotor. This construction enables a rotor to be removed and gives access to the windings without disturbing the thrust bearing. It also keeps all oil beneath the rotor and precludes the possibility of leaking oil being thrown into the windings.

Provision has been made for testing the units by the salt velocity method, by piezometers, manometers, and in accordance with the Winter patents. In the first named, salt will be introduced at the intake, and the electrodes are situated between the butterfly valve and the scroll case. The piezometer taps are near the entrance to the scroll cases. This equipment will furnish a means of determining flow of water and losses in penstocks.

The Saluda River Development was built by W. S. Barstow and Company, for the Lexington Water Power Company.

The inventors of the new electrical test which measures the hardiness of plants and helps reduce winter crop losses. From left to right: S. T. Dexter, W. E. Tottingham, and L. F. Graber. This test may have great economic significance

A NEW ADVANCE IN FOOD PRODUCTION

By RENSSELAER SILL

SEARCHING for a way of measuring the ability of plants to withstand the hazards of winter, three Wisconsin scientists have perfected an electrical method for testing hardiness that promises to be of considerable value to agriculture and to unlock research fields only touched upon in the past. The economic importance of such a discovery to American agriculture becomes obvious when it is realized that the hardiness of plants can now be tested with their method in a few minutes, and that severe losses caused by the winter-killing of crops can be reduced.

In the past the ability of plants to resist winter weather was measured simply by planting them in plots and observing how they withstood low temperatures. Naturally, this method required several years. It also slowed up the determination of hardiness, and lengthened out by perhaps three or four years the testing of new varieties of alfalfa, clover, corn, grains, and so on. Perhaps, in the average case, the first winter plants were under observation happened to be exceptionally mild, and the second year extremely severe.

This resulted, of course, in killing all varieties. Then the only recourse would be to re-seed the test plots and start all over again. It was only good luck if the first few winters happened to be of the right severity for experimental purposes, and even then there always was the danger that other factors beside low temperatures might have been partly responsible for winter injury.

THEN, too, with the old method of testing it was almost impossible to discover the precise temperature the plants could withstand with profit to the farmer. It was exceedingly difficult to uncover answers to such questions as the following: Precisely what is the effect of the soil upon winter-killing? How does the storage of food reserves in the roots of plants help them to conquer winter dangers? What provisions does nature make for protecting her plant life during periods of severe cold? Does cloudy weather during the late summer affect the hardiness of plants? A number of other questions of keen interest to farmers and men of science required answers.

Although the new method for testing the hardiness of plants has not answered all these questions, it has succeeded in opening up an angle of approach to their solution. With this method, men of science actually can control the temperature to which the experimental plants are subjected, can measure accurately the effect of low temperatures on different kinds of plants, and can test the hardiness of individual plants in such a way that they will not be destroyed and thus can be used for plant breeding work if desirable.

Like many other discoveries that have helped put farming on a scientific basis and have aided in insuring the world an adequate food supply, the recently discovered method for determining the hardiness of plants is marked by its simplicity. The Babcock test for butterfat, which virtually revolutionized the dairy industry and made it possible to conduct tests on the production of individual cows; the tests for determining the lime and phosphorus requirements of the soil; and the various tests for some of the plant and animal diseases—these likewise are of outstanding simplicity.

Scientific discoveries, regardless of how evident they may seem and how simple the methods employed in making them may be, do not just happen. So it was with this discovery, which was made in the research laboratories of the University of Wisconsin by S. T. Dexter, a young agricultural chemist, who worked with W. E. Tottingham, another chemist, and L. F. Graber, n agronomist known for his work [illegible] alfalfa

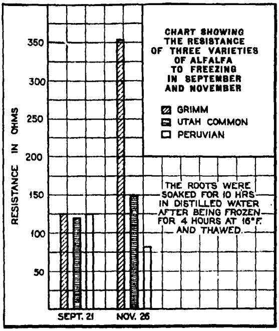
BELIEVING that there must be [illegible] chemical diffe[illegible] in plants in the hardened and unhardened condition, these workers set out to determine the precise [illegible] ıch differences. The first step was the choice of a suitable plant to work with. Among the many plants that could have been used in the experiment, alfalfa finally was chosen because of its great economic importance to Wisconsin and to American agriculture. Alfalfa is an outstanding hay crop and is a legume. Thus it aids in keeping up the nitrogen supply of the soil. It is rich in minerals and proteins, makes heavy yields, and is an excellent roughage for livestock. Indeed, this crop is responsible [illegible] no small extent for the rapid growth of part of the dairy industry and for bringing into cultivation many abandoned farms.

Now it generally is agreed that the injury or killing of plants by cold or any other means involves the disorganization of substances essential for carrying on the life processes. With such disorganization, plant cells lose their capacity to regulate the diffusion of their soluble contents. For example, frozen potatoes upon thawing become soft and mushy, a condition caused by the breaking down of the cells and their contents, which then no longer have the capacity to hold on to the materials which are essential to life. Precisely the same thing happens to plant roots when they are injured by low temperatures.

Upon this basis it was assumed that the extent of plant injury from cold might be related in some way to the loss of stored materials in the roots. These materials include various kinds of minerals which are good conductors of electricity. Such conductors are called electrolytes.

To test the soundness of the hypothesis that the amount of such materials lost from the roots might be related to the extent of frost injury, alfalfa roots of three varieties of known hardiness (Grimm, Utah Common, and Peruvian) were frozen under controlled conditions for various lengths of time and at different stages of growth during the fall months. The diffusion of materials from the roots then was measured.

Through the results of thousands of test plots of these three varieties of alfalfa, scientists already had learned that the Grimm was the hardiest, the Utah Common less able to withstand freezing, and the Peruvian the least hardy. If the experiments checked with these facts laboriously discovered through actual field tests over a long period of time, the new electrical test for hardiness probably would be accurate.



After the roots of the three varieties of alfalfa of known hardiness were frozen they were thawed out and soaked in distilled water for ten hours. Preliminary work had revealed that there was very little diffusion of cell contents after the ten hour period.

The distilled water in which the frozen roots had been soaked was then poured into a conductivity cup, which is simply a small glass cup containing two platinum poles. An electric current was next passed through the liquid. It was found that the roots which were uninjured by freezing did not give up their cell contents and consequently the distilled water offered a high resistance to the current. But the cells of roots which were badly injured by low temperatures gave up salts and thus offered a low resistance because of the electrolytes in the liquid.

By measuring this resistance offered by the water in which the frozen roots of varieties of different degrees of hardiness were soaked, it was relatively simple to determine whether or not the amount of materials lost by the cells was an index to the ability of plants to withstand cold weather. To discover what relationship existed between subsequent growth and the amount of injury from each freezing treatment, 24 plants of each variety were transplanted in soil under greenhouse conditions. In general, the growth of the plants showed a distinct correlation between the loss of materials from the roots and the extent of injury from the freezing treatments.

That different varieties of plants prepare to fight the low temperatures of winter with more thoroughness than do other varieties, also confirmed by this method of testing the hardiness of alfalfa. Some hardy varieties, such as the Grimm, slow up in growth early in the fall and start storing large reserve supplies of food in their roots, while others, such as the Peruvian, keep growing and store relatively less food materials in their roots and stems. Those varieties that prepare for winter usually survive even severe cold, but those that are caught in their growth period by cold weather are often winter-killed.

THIS fact was discovered by measuring the out-go of materials from the roots of different varieties that were dug and frozen early in September. At this first freezing no varietal differences were found in ha[illegible] the roots were dug out of the ground and frozen during the latter part of October and in November, differences in the ability of varieties to resist cold weather became evident.

Thus, plants go through a hardening process in the fall which prepares some varieties more than others to withstand cold winters. (See chart.) Just what this hardening process is remains unknown, but it is not at all unlikely that the new test for hardiness will be helpful in uncovering the secret that has baffled scientific men for the last half century.

In addition to measuring the hardiness of alfalfa by this electrical method, tests conducted on wheat, apples, raspberries, and other woody plants, indicate that their hardiness also can be measured by the amount of materials lost from their roots. If further research checks these preliminary experiments, facts will be unearthed which may reduce severe winter crop losses, the plant breeder will be able to breed varieties of plants of almost undreamed of hardiness, and it is not altogether visionary to see areas in the northern states producing crops hitherto limited to the south. Indeed, the food-producing areas of the world may feel the effects of such a discovery more than we suspect.

Perhaps the most interesting phase of the electrical test for hardiness in plants is the new research it opens up.

COMPANIONS IN DEPRESSION*

By RAYMOND B. FOSDICK

IF I may put it bluntly, our world is very sick. It is a world which engineers and technologists have created. They have given us radios and telegraph systems and airplanes and automobiles and other marvelous methods of communication and transit. They have given us harvesters and turbines and all sorts of automatic machinery. These gifts have knit the world together into a new kind of unity; they have made possible the organization of production and distribution on a gigantic scale; they have increased the standard of living far beyond even the dreams of our fathers; they have resulted in higher wages, shorter hours, lower prices, and larger profits. And yet I repeat: the world we live in today is very sick.

If anyone doubts this assertion let him feel the pulse and take the temperature of the present situation. All over the world during the past year production has declined, commodity prices have fallen, bankruptcies have increased, agriculture has become chaotic, and the figures of unemployed have mounted with almost unparalleled rapidity.

NOW the awakening has come. We are faced with a stagnation of industry such as we thought would never occur again. Apparently the problem of the machine age is not so much a problem of producing goods as it is of producing buyers. We cannot move our wheat abroad, for there is little demand for it, and consequently the purchasing power of our vast farmer class is paralyzed. Our cotton is rolling up in our ports like gigantic snowdrifts and the price has fallen to an abysmal depth. In copper, steel, motors, merchandising, and a dozen other industries, the story is the same: a drying up of the stream of consumption, a slowing down of production, curtailed output, falling prices, passed dividends, staggered hours of work, half-time work, quarter-time work, no work.

We are not going to be saved from all this by a slogan. Industrial depression cannot be cured by any such shallow approach. The causes lie too deep and are too complex and widespread to be removed by so simple a remedy. With one method or another we shall doubtless effect an improvement in our present situation; but before we begin to think in terms of permanent cure, before we can be sure that whatever amelioration we accomplish is more than temporary, it will be necessary for us to face, more frankly than we have faced, some rather fundamental facts.

The country is full of remedies. But in trying to think our way through the difficulty remember that we are living in a 20th Century, and not an 18th Century, industrial world. The difference between the two needs no elaboration. Our new world is a world of interdependence and solidarity. It is a world that machines have woven together with thousands of criss-crossing threads. It is a world in which the relations between cause and effect have been so lengthened that on any given day the Egyptian planter cannot know what his cotton or sugar is worth until he receives the quotation from Galveston or Cuba. A heavy frost in the Mississippi Valley will affect prices on the Liverpool exchange, and the disturbance will reverberate in Australia and India.

The chain of economic consequence is practically without end. French savings, through the channel of a loan to Argentina or Chile, contribute to the development of German or Belgian industry. Prosperity in Czechoslovakia, by increasing the consumption of chocolate, results in the stimulation of the plantations of Venezuela. This complex play of action and interaction which constitutes our 20th Century industrial civilization could be portrayed in endless illustrations.

MEANWHILE the ports on the world's seaboards continue to grow. Each time a dock is built at Montevideo it is necessary to add a dock at London and at Hamburg. One nation extends its agricultural hinterland while the other increases its hinterland of factories. One nation lends its capital (we Americans have 20 billion dollars in private investments overseas) and the recipient nations in return increase their imports and add to their equipment.

The solidarity of this new world of ours is the result, of course, of specialization. Each country makes its particular contribution, dependent upon its own resources and capacities, to the goods that the world consumes. Italy has no coal or iron; France has no oil; Great Britain must import two thirds of her food supply; the United States is dependent on other countries for tin, silk, nickel, rubber, and many other commodities. The War Department in Washington has listed 30 specific materials which are called strategic because they are essential to the prosecution of war, and because we either do not produce them at all, or can supply them only in quantities insufficient even for peace-time requirements.

A country that could not make a locomotive, an automobile, or an airplane without materials from abroad can scarcely be called self-contained. A country that could not even carry on war without the aid of 30 essential commodities from other nations cannot boast of its national independence. By the same token, a country whose excess wheat and cotton are rotting in fields and storehouses because its foreign market has gone to pieces is not in a position to talk in terms of Washington's Farewell Address.

YOU see, do you not, what has happened? In a hundred years, thanks to machines, the rush of trade and finance has trampled down the old geographical frontiers. Everywhere economic forces have broken through old barriers and are seeking common levels. Around the world prosperity and depression keep the same rhythm, and rise and fall together like the ebb and flow of the sea.

Now there is no doubt that there are many things that could be done and are being done here in the United States which would and will improve our internal situation. The revision of our anti-trust laws, as suggested by Mr. Thomas W. Lamont, with their unfortunate consequences in terms of duplication of plant and equipment, might very materially encourage our economic recovery. The repeal of our recently enacted tariff law with its vicious boomerang against our own export trade would undoubtedly help. The establishment of a National Industrial Planning Board, as outlined by Mr. Stuart Chase, which would act as an economic general staff—a fact-gatherer and adviser both for government and industry in relation to every major economic undertaking—might be of great assistance in articulating the development of business and thus meeting the challenge of the Russian formula. Similarly we could and probably should have legislation establishing a national system of employment exchanges, unemployment insurance, advance planning of public works, and other emergency remedies.

The fundamental difficulty with our present situation is that two distinct principles are struggling for mastery. In spite of the fact that the economic tides are overflowing the world, we are still trying to maintain our old nationalistic water-tight compartments. Our political conceptions have not caught up with our machines. We still cling to the idea that we can maintain political isolation in a world in which economic isolation has long since gone by the board. Although commerce and trade have far transcended the framework of the nation, we still continue to think about them in terms of absolute national control.

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*Abstracted from an address delivered before the Carnegie Institute of Technology.

It all comes down to this: we are trying to run a 20th Century industrial world with 18th Century political ideas. The tremendous technical revolution of the last hundred years has as yet made little impression upon our institutions or social beliefs. The United States, for example, continues to live in the intellectual atmosphere of Jeffersonian individualism. Its administrative system is roughly the same as it was in the days of Jackson. Its philosophy of international relations is inherited from Hamilton. It repeats the Declaration of Independence as if nothing had happened since 1776.

IN brief, the United States is trying to live in two different worlds at the same time. A leader in everything that relates to the advance of the technical aspects of economic interdependence, it refuses to face up to the political implications of its own acts. It cannot bring itself to believe that airplanes, five-day boats across the Atlantic, and telegraph systems are fundamentally incompatible with our inherited ideas of national independence. All over the world, in every country, there is this same chasm between the new life and the old ideas, this same obstinate adherence to antiquated political formulas as a solution of modern economic problems.

But let no one imagine that the solution is an easy one. It involves a voluntary curtailment of the field of so-called sovereign rights—a relinquishment to group decision of many matters which hitherto have been considered of exclusively national concern; even more than that, it involves the immense difficulty of securing common agreements between nations whose racial and cultural backgrounds are utterly diverse.

As far as the United States is concerned, a solution along lines of international action will call for a re-orientation of our present point of view and a sharp reversal of our present practice. We shall have to give up our secretly cherished belief that the ultimate test of law and morals lies in an enclosed territory. We shall have to be willing to play our part, not as an onlooker, but as an active participant, in the wider organization of the world community.

Raymond B. Fosdick, the author, is, among other things, a well-known lawyer, a trustee of the Rockefeller Foundation, and a member of the American Academy of Political and Social Science. He has a long and notable record of public service, both local and national

Whether it is the League of Nations, or the Court of International Justice, or the International Labor Office, or the Bank of International Settlements, or the International Chamber of Commerce, or whatever may be the machinery, official or non-official, by which the overlapping interests of nations are given voice and expression, we must be prepared to make our maximum contribution and carry our full share of the common enterprise.

The new solution involves the necessity of sitting down with any nation or group of nations to discuss any matter whatever of common concern. More than that, it involves a self-denying ordinance by which we will refrain from action prejudicial to other nations, at least until we have joined them around the conference table in the hope of mutual agreement.

The question of tariff is a case in point. The tariff is not a local issue; it is not even a national issue; it is an international issue which should be handled by some kind of international technique.

In the Tariff Act that was recently passed in Washington, 890 different items were increased, affecting imports from nearly every country in the world. Following the passage of the Act there came from other nations a volume of angry protests and retaliation which has scarcely diminished to this day. The Act was a blow struck by one nation at the economic stability of 60 nations.

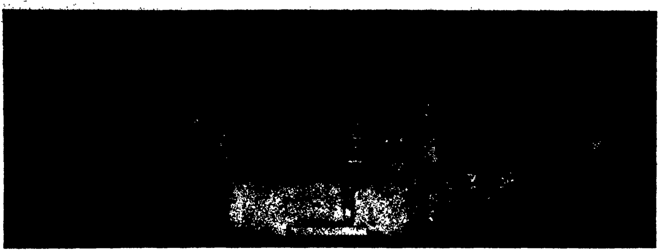
Take the case of Switzerland, for example. The Swiss Republic is to a large extent a nation of watchmakers. She has no natural resources; she imports all her raw materials. She has been shipping to the United States approximately 11,000,000 dollars' worth of watches and watch movements every year. Our new tariff bill closed the doors of many of her factories. A handful of men, sitting around a table in Washington in an atmosphere heavy with ignorance and cigar smoke, crippled the chief industry of a country 3000 miles away.

This is not world order. It is anarchy. Even from the standpoint of our own self-interest it is catastrophe. For Switzerland was buying from us 45,000,000 dollars' worth of goods a year. With her principal industry disorganized, and with the ramifying effect of that collapse upon her own purchasing power, with what funds will she buy from us in the future, even if she now had the desire?

The old doctrine of "Each for himself and God for us all" which Canning enunciated a hundred years ago after the wreck of the Holy Alliance, does not fit into a 20th Century world. A national tariff act, passed in utter disregard of its consequences abroad, is today an anachronism. It is a throwback to an age of savage conquest. The whole question of tariffs belongs in the international field. It is a problem for common counsel and joint consideration.

THIS, then, is the prescription which destiny seems to be writing for our sick world: we must bring our political ideas abreast of our industrial internationalism; we must close the gap which our machines have made between politics and economics. Local remedies may afford temporary relief. Our enormous potential consuming capacity will certainly assist recovery. But the attacks will come again, and, because of the growing complexity of international relationships and the fast developing physical propinquity of peoples, they will come with increasing severity. For some of us the medicine that has been suggested will be bitter. But there seems to be no other method of permanent cure. And the patient is very sick.

In 1927, a World Economic Conference, called by the League of Nations, stated in its report that "it was a mistake to assume that the economic condition of Europe could be so seriously disorganized without affecting the rest of the world." We, here in the United States, did not believe it then. We were at the top of our gait, and the bread lines of Europe were a long way off. Now we know that what they said was true. We are all in this situation together. British, Germans, Spanish, South Americans, Asiatics—we are companions in depression; and we humbly subscribe to that further sentence in the report of the Economic Conference: "Prosperity is not something that can be enjoyed in small compartments."



Above: Looking down on the top of the upper car showing cables attached to the center. Cables for lower car at sides

Below: Top view of lower car showing ropes attached to the outer ends of the sling. Aluminum is largely employed

TWO CARS IN ONE ELEVATOR SHAFT

By H. D. JAMES
Consulting Control Engineer, Westinghouse Elec. & Mfg. Company

RECENT articles have shown that the height of a building is not limited by the mechanical structure and that buildings even a mile high can be built if there is any justification for them. High buildings of the tower construction may be built for advertising purposes, but most buildings are erected as an investment and the vertical transportation problem is the feature which places an economic limit on the height, due to the floor space required for the elevator shaftways. Fifty square feet is a very conservative estimate for the size of an elevator shaftway which we may assume can be rented for four dollars per foot; this multiplied by the number of floors in the building represents a very considerable revenue.

Engineers have been working on this problem and the best solution so far offered is to operate more than one elevator car in the same shaftway. This will reduce the total number of shaftways and release a considerable floor area for revenue purposes.

The Westinghouse Electric & Manufacturing Company have recently completed an elevator installation of this kind in a shaftway attached to their new office building at East Pittsburgh. This is the first installation where two independent elevators are operated in one shaft on a commercial basis. Each elevator car has a capacity of 3000 pounds at 600 feet per minute and is controlled by a full automatic push-button system which stops the cars automatically at the desired point by use of inductor relays. The top car operates from the third to the eleventh floor and the bottom car from the first to the ninth floor.

Obviously both cars should run in the same direction, on a fixed schedule. Nothing can be gained by trying to run the cars in opposite directions except under abnormal conditions. Provision is made in each car to change the control from automatic to hand operation, which will permit slow movement of either car toward the other. This provision is intended to be used only as a matter of safety in case a passenger were caught in the enclosure door or the automatic control did not properly land the car.

When one car is operated in the hatchway, automatic means stop it before it reaches the limits of travel. When two cars are operated in the same hatchway each car becomes the limit of travel for the approaching car and in general the same safety means stop the approaching car before it reaches the limit of its travel.

The floor selectors for both cars are mounted together in the penthouse and attached to a miniature pair of elevators, operating in an illuminated hatchway, with ground glass front. Each floor is indicated and all of the parts are to scale so that it is easy to follow the operation of the two cars.

The cars are normally operated on a block system of control similar to the trains in a subway. When one car approaches the other, it is first automatically slowed down and then stopped by means of the same control which is used for its normal operation. The operator in the car has a set of three signal lights. A green light indicates that he can run full speed; an amber light is a caution signal requiring half speed; a red light means stop.

A SET of differential gearing, located at the top of the shaft, is provided with two elements, one of which is attached to each car by means of a steel tape. Automatic devices stop both cars if either steel tape becomes slack. The differential gearing indicates the relative position of the cars and operates to slow-down and stop the approaching car if the block system should fail. The action is selective; the leading car does not have its control interfered with. Every facility is provided for the leading car to clear the block and provide safe running space for the following car. The speed of the approaching car is reduced and the car finally stopped in three stages by the differential gearing.

Oil buffers stop the car at either limits of travel in the usual manner. In addition to this, an oil buffer is placed between the two counterweights to prevent shock should the two cars drift together. At the same time a set of emergency switches located between the cars is operated to disconnect the electric power.

The two counterweights are operated on the same set of rails. The upper one is provided with a safety to prevent its dropping on the lower one in the event that the ropes become detached.

The hoisting cables for the lower car lead down either side of the top car and are attached to the cross beam of the bottom car at either end on opposite sides of the center line passing through the guide rails. The other ends of these hoisting cables are attached to the outer ends of the counterweight. The distance between counterweight rails is approximately the same as between car rails. The top counterweight is attached to the bottom car.

The hoisting ropes are attached to the top car at the center and lead to the bottom counterweight through a slot in the upper counterweight. This arrangement is similar to the old drum machines using a separate car counterbalance.

Aluminum was used wherever the reduced weight improved operation. The [illegible] sling and platform framing are [illegible] aluminum. A combination of alum[illegible] and Micarta gives the c[illegible] a very unusual and attractive [illegible]ance. The saving in weight of the car and sling is considerable. This reduces the power consumption and the stresses on the equipment and supporting structure and therefore improves the service and naturally reduces the cost of operation.

The enclosure doors are made of aluminum with Micarta panels. These doors weigh about half as much as the ordinary steel door and consequently require only half the energy to operate

View of car and control board. Car is made of aluminum and Micarta, reducing weight and running costs. See the text below

Right: Lower penthouse holds upper car machine. Lower car cables at the left near the governors

Below: Upper penthouse drive for the lower car. Cables at both sides pass upper car in the shaftway

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

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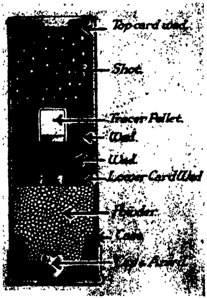
Editor *Journal of the American Medical Association*, and of *Hygeia*

Easy Way to Melt Snow Blanket in Spring

WHEN "winter, lingering, chills the lap of May," foresters of the United States Department of Agriculture sometimes call into play a trick of the trade that puts an end to the unseasonable loitering. In some years it happens that sites chosen for reforestation by planting are ready for seedlings from the forest nursery while the nursery is still buried in snow. By the time the snow in the nursery has melted and the trees are ready for transplanting, the soil in the planting sites may be too dry. The problem in such a case is to melt the snow and advance the working season in the nursery.



The trick is simple—when you know it. It consists in broadcasting fine black soil on the snow over the compartments of the nursery from which planting stock is to be removed first. This soil, because it is black, absorbs considerable heat which would otherwise be reflected from the white snow. This hastens the melting of the snow and enables the workers to get out the planting stock earlier—as much as two weeks earlier in some instances.

This practical and simple application of one of the elementary principles of physical science, as adopted by the Forest Service, may also find other work to do, officials of the department suggest. For example, a similar broadcasting might advance the time when it is possible to work the home garden.

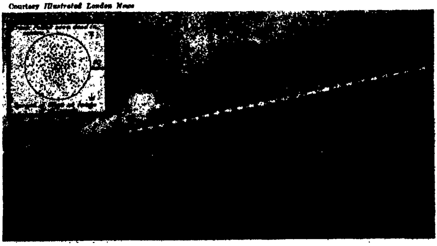
Diabetes and Sugar Consumption

THE idea that diabetes is caused by eating an excess of sugar is so prevalent that the popular name for the condition is "sugar diabetes." Recent studies made by special investigators of this disease indicate that it is not so much the excess of sugar that does harm to the diabetic as an excess of food generally. Diabetes is inconspicuous among orientals who live largely on cereals. It was, moreover, quite as prevalent in Germany as in the United States at a time when the sugar consumption in the United States was far beyond that of the former country.

A recent survey of the relationship of sugar consumption to diabetes was made by C. A. Mills of the University of Cincinnati. His studies failed to reveal any direct relationship between the consumption of sugar and deaths from diabetes. Some countries with a high consumption of sugar, such as Hawaii and Argentina, had relatively low rates for diabetes, while some countries with a high death rate from diabetes, such as the Netherlands, have a very low suga consumption.—*M. F.*

At the left is shown a new shotgun shell which carries a tracer pellet which is ignited by the powder charge thus tracing the trajectory and allowing the sportsman to correct a faulty aim. At right, the tracer shell being used in trapshooting. It is manufactured in England

Courtesy Illustrated London News



Preventing Rust in Water Systems

IN many manufacturing operations, and especially in air conditioning installations, water is sprayed into the air or flowed over open condensing systems. In such cases, the water becomes saturated with oxygen. This condition is just right for causing rust, and rust is the *bete noir* of the engineer and operating man. In most of these systems the water is recirculated with only enough make-up to keep the volume constant.

It has been found that a judicious application of silicate of soda added either by a slow continuous feed or at regular intervals prevents rusting under such conditions. It is not necessary to exercise a very accurate control, though eight parts of silica per million of water will be about right. The action of the silicate is believed to be the formation of a very thin invisible film of silica which interferes with the transfer to the metal of oxygen dissolved in the water. The film must be kept intact by keeping silicate in the water which would otherwise dissolve the film, and the rusting would merrily proceed. *A E. B.*

The Baker's Dough Evaporates

THIS is written just as the Christmas bills are coming in, s[illegible] priate for some data on [illegible] evaporation of "dough." We thought [illegible] money disappeared with record speed, but now we re[illegible] of bakers' shops where tons of dough literally evaporate every day.

Loss of weight of dough during fermentation under practical shop conditions has amounted to as much as 6 percent, while the average loss in the plant under good control can be held down to about 0.5 percent. Some weight loss will always take place during fermentation, but large losses due to evaporation may be prevented. P. G. Perrie, writing in *Bakers Weekly*, is authority for these statements. He recommends that materials should be weighed accurately, humidity should be controlled—70 to 75 percent relative humidity in the dough room is desirable—and suitable records should be kept. In one bakery, a five-oven plant, evaporation losses in the dough room were found to be equivalent to 100,000 pounds of dough per year.—*A. E. B.*

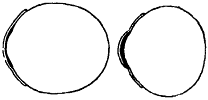
Contact Eye-Glasses

NEW hope for millions who daily are conscious of the "nuisance value" of those cumbersome appliances known as eyeglasses seems to lie behind the recent development of so-called "contact glasses." These are simple little eyeball caps of optical glass, without rims and without bows, in fact without any method of attachment to the human anatomy other than support by the eyelids and adhesion to the eyeball, with which they turn under control.

Four examples of contact glasses ground to different optical prescriptions. These tiny shells—shown approximately full size here—are fitted under the eyelids

The very simplicity of the idea will make immediate appeal to persons of scientific and mechanical leaning. The little shells are scarcely larger than one's thumbnail and, being made of glass only one-fiftieth of an inch in thickness they weigh no more than seven grains. One might assume that they would soon be broken, since they are so thin, and do injury to the eye. On the contrary the chances of breakage seem to be extremely small, for the concave cups are situated in a most advantageous position, just the reverse of ordinary eyeglasses which are ideally situated for breakage. In fact, contact glasses partake of the same protection nature affords the eye itself—location in a depression behind the ring formed by the cheek bones below and the brow above.

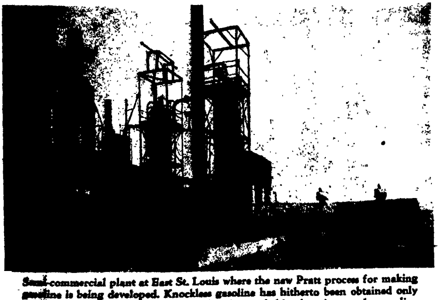
Obviously the curves of the contact glasses must fit the eye of the individual user and this demands no small amount of painstaking when they are fitted. Parts of the eye must be anesthetized and the wearer must expect to make numerous trips to the oculist. Dr. A. Rugg-Gunn describes the necessary technique of fitting in an article in the *Lancet* (London), and makes no attempt to minimize these difficulties which, he says, are "obviously great."



The manner in which the new contact eyeglasses fit the wearer's eye

Before the cups are applied to the eyeball they must be filled with a fluid having a refractive index approximating that of tears. Then as the wearer leans forward they are applied directly to the eye by means of a small rubber vacuum cup temporarily pressed to their outer surface. A little thought of the optical principles involved will reveal the fact that, optically, these artificial outer lenses, because of the liquid held behind them, abolish the effect of the cornea and, since astigmatism occurs in the cornea, they abolish astigmatism while they are worn. Incidentally, they are so thin that they are practically invisible.

With regard to contact glasses there is only one "fly in the ointment" but it appears to be a large fly—they are difficult to fit and, especially if the contact of the marginal part is not uniformly perfect, they are likely to irritate, becoming, as Dr. Rugg-Gunn says, "intolerable." Yet there is so much in the idea which will make appeal to those who have wished for the 10,000th time that all eyeglasses were in Gehenna, that it is hoped the research workers of Carl Zeiss who developed them in refined form will persist until, finally, all those who are forced to wear the conventional form of eyeglasses can celebrate the day these safely can be consigned forever to the ash can.



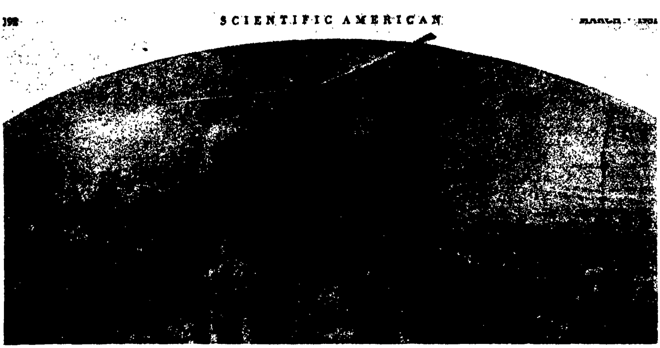
Semi-commercial plant at East St. Louis where the new Pratt process for making gasoline is being developed. Knockless gasoline has hitherto been obtained only from choice grades of crude oil but the object of this plant is to make gasoline from almost any grade of crude. It is said to produce 300 barrels daily by a vapor-phase cracking process using temperatures up to 1100 degrees, Fahrenheit

Violin Bows Made of Silver Threads

VIOLIN bows, which have been strung with horsehair ever since the Middle Ages at least, may soon have to yield place to a new form of an old material. A German violinist has been experimenting with bows strung with silver wires of hair-like fineness, slightly roughened on their surfaces to set the violin strings vibrating. It is stated that a sensitiveness and brilliance of tone are achieved that excel the effects usually obtained with the old horsehair bows.—*Science Service.*

The Rate of Wound Healing

SOME of the most sensational announcements appearing in recent years have had to do with the use of what is called the electrical knife for surgical operations. One advantage claimed for the electrical knife is the fact that it seals the tissue at the time the cut is made, thereby lessening bleeding. It has also been urged that the wounds made by the electrical knife healed more rapidly than those made by other techniques. In some instances the use of the cutting current with just enough electrical desiccation to control oozing of blood has permitted surgery which formerly could never have been attempted. These instances concern particularly the control of brain surgery, the removal of parts of the liver



The Autogiro in flight in the disturbed air currents over New York City

and spleen and extensive excisions of cancer.

It is the belief of Dr. John D. Ellis that the claims regarding rapid healing following electrical cutting are not warranted. In a series of carefully controlled studies he found that only 60 percent of electrically produced wounds showed primary healing in comparison with 97½ percent of primary healing in wounds made by the ordinary scalpel. He found, furthermore, that when healing did occur in wounds made by the electrical knife the union was weaker than in corresponding wounds made by the scalpel. The same general results were found in cutting the walls of the stomach and in cutting muscle.—*M. F.*

The Autogiro

SEVERAL requests from readers for authentic information on the "flying windmill," the autogiro, have brought about the decision to devote almost the entire aviation section of the Digest this month to that subject. Professor Klemin has therefore prepared the following description which will answer many of the questions about the autogiro that arise when one first views that ship in flight.—THE EDITOR.

LA CIERVA'S Autogiro, with its remarkable landing properties, its freedom from any tendency to spin, and its long record of successful flights unmarked by a single fatality has aroused wide public interest. No less a personage than Thomas A. Edison has expressed enthusiastic approval after examination of this new type of aircraft at Newark Airport. Our readers may perhaps be interested in a review of its history and present status.

Its History

THE invention of the Autogiro is due entirely to a sheep! In 1918 Juan de la Cierva designed an excellent three-engined bomber for the Spanish Air Force. Flying from one field to another, he saw a sheep directly in his line of landing. He pulled back his stick to avoid the sheep, stalled the airplane, and crashed. So at least we learn from Flight Lieutenant Bonham-Carter of the British Royal Air Force. *Si non è vero, bene trovato.* Cierva spent a sleepless night or two, and determined to build a craft which would not stall. Hence the Autogiro.

In 1920 he first conceived a freely rotating wing as the best means of achieving his purpose.

In the ordinary airplane, loss of forward speed means loss of lift and all its attendant troubles. With a rotating wing, when the craft as a whole is flying at low speed, the rotating blades still have considerable speed and therefore lift. Hence the possibility of very low landing speeds, and almost vertical descent.

The first type of Autogiro tested was fitted with two four-bladed rotors mounted one above the other. The purpose of the two systems rotating in opposite directions was to eliminate the difference in lift existing between the blade going into the wind, and the blade moving away from the wind of forward motion. Probably owing to interference between the two rotor systems and the consequent loss in efficiency, the type was far from being successful.

The second attempt had a single rotor system of three blades, which was set at varying incidences, as it rotated, by a mechanical device, also designed to eliminate the difference in lift and the resulting turning moment. This was an improvement over the first type, but the mechanism proved cumbersome and ineffective.

The third type of Autogiro was fitted with a rotor of five rigid blades, and was the first full sized machine actually to leave the ground. Unfortunately, whenever a rigid rotating system changes its plane of rotation, gyroscopic moments are set up. The gyroscopic moments proved too large to be controlled and this type also had to be abandoned.

Finally Cierva hit on the principle of articulated blades, freely hinged at or near the axis of rotation. In forward flight, as we have stated previously, there is more relative wind speed and hence more lift on the blade advancing into the wind than on the blade receding from the wind. But when the blades are hinged, the advancing blade rises. As it rises, the air strikes it from above and the increase in lift ceases. Equilibrium is established between the weight of the blade, the centrifugal force, and the air forces. Since the weight of the blade is always the same, the lift on either side remains substantially the same. Even if the difference in lift is not entirely eliminated, the freely hinged blades cannot introduce rolling or pitching moments into the body of the machine.

Another great advantage of the hinging of the blades is that gyroscopic moments are eliminated when the aircraft, as a whole, is pitched or rolled.

This fourth type was notably successful. However, lateral control was provided for by tilting the axis of the rotor to the right or left, and this proved impractical. Nevertheless, the fundamentals of success had been determined. The machine was reconstructed or modified 15 times, a better type of lateral con-

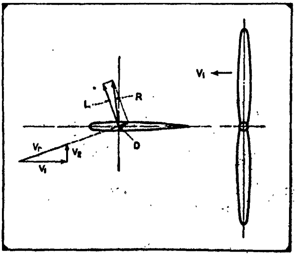


Diagram illustrating the rotor principle trol was evolved and in January, 1923, a successful flight of about 200 yards was made near Madrid, and subsequently a flight on a closed course at the famous Quatro Vientos Airdrome.

The Principle of the Rotor

PERHAPS the most puzzling thing for the layman to understand is in the principle of auto-rotation of the lifting rotor.

The easiest aspect of the problem is auto-rotation of the rotor in vertical descent. Suppose we have a blade as shown in the appended sketch, rotating in the direction shown. There is an air velocity relative to the blade, due to its rotation, of amount V_1. There is also an air velocity relative to the blade, due to the descent, of amount V_2. The resultant of these two velocities, V_r, strikes the symmetrical blade at an angle. The lift, L, of the blade is always perpendicular to the resultant wind velocity. Therefore, the lift has a forward component, which overcomes the drag, D, and keeps the blade in rotation.

Similar considerations of a somewhat more complicated character explain how the blade is kept in rotation in forward flight. *There is no application of power* to the axis of rotation. Once the Autogiro has started on the ground, and the "windmill" has been set in motion, rotation continues.

Autogiro and Airplane Compared

IN Cierva's opinion the Autogiros recently produced have no better performance than the equivalent conventional airplanes. In fact they have a little less speed and a little less climb than the best equivalent airplanes. Nevertheless he considers them better flying machines. Summarizing comparative performances, he states: "Top speed, 5 to 10 percent less. Rate of climb, 20 percent less. Minimum horizontal speed, 50 percent less. The take-off since the introduction of the deflector tail is better. The landing qualities are so well known that it is hardly necessary for me to mention them. In any case I want to state that the present day Autogiro can, with proper handling, be landed in perfectly still air, with no run at all after touching the ground. In steep descent of about 45 degrees the vertical speed of the latest machines is not more than 12 to 13 feet per second."

Airplane exponents argue that the wide speed range of the Autogiro can be met by the use of slots and flaps applied to the conventional wing; that the greater average speed of the blades as compared with the speed of the fixed wing means always higher drag, and therefore less efficiency and top speed; that the Autogiro will never be able to compete with the refined t[illegible] airplane in load [illegible] capacity and gene[illegible] formance. Still Cierva and his American licensee, Harold F. Pitcairn, have cogent arguments and tests in rebuttal of these hostile views.

This close-up of the landing gear shows the exceptionally wide tread, long travel, and novel design

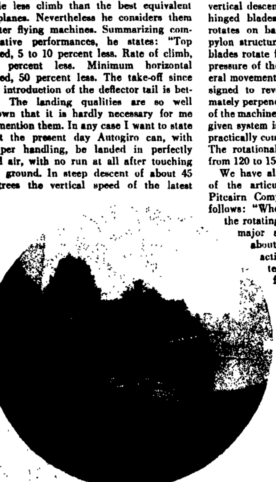
The Modern Autogiro

WE are indebted to the Pitcairn-Cierva Autogiro Company for an excellent collection of photographs which illustrate the construction of the Autogiro as it is to-day.

Let us examine the photograph of the Autogiro flying comfortably over the disturbed air of Manhattan. There are four long thin blades in rotation above the craft. This characteristic rotor system furnishes approximately 80 percent of the lift at high forward speed and 100 percent in vertical descent. It consists of a set of four hinged blades mounted on a hub which rotates on ball thrust bearings set on a pylon structure above the fuselage. These blades rotate freely under the aerodynamic pressure of the wind produced by the general movement of the craft. The rotor is designed to revolve about an axis approximately perpendicular to the longitudinal axis of the machine. The speed of rotation for any given system is defined by its design and is practically constant for all flying conditions. The rotational speed of the rotors varies from 120 to 150 revolutions per minute.

We have already explained the function of the articulation of the blades. The Pitcairn Company explains its action as follows: "When the Autogiro is in flight the rotating blades are subjected to two major and opposed loads brought about by natural forces. Under the action of lift the blades have a tendency to rise, since they are free to move about the hinge at the roots. This tendency to rise is overcome by the centrifugal force of rotation acting at right angles to the lift force. The equilibrium of the two forces results in the rotor system coning slightly in flight." This coning is quite apparent in the photographs.

With reference to the details of the r[illegible] note that the rotor syst[illegible] three ball bearings, any two of which are designed to take the full load. Each blade is joined by a universal joint to the forging which constitutes the rotor-head. This construction permits flapping upward and downward, and a movement of one blade with respect to the other, but prohibits any change in the angle of incidence of individual blades. The hinges which form this universal joint are plain journal bearings. "Droop" cables prevent the blades from falling when centrifugal force is absent. Immediately below the rotor-head may be seen the drive shaft and over-running clutch of the mechanical starter which brings the rotor to its speed of 120 revolutions per minute before take-off of the machine.



Autogiro landing at low speed. The demonstra- [illegible] s because of the barrier of trees

The starter derives its power directly from the engine crankshaft through a manually operated clutch, and brings the rotor up to speed in less than half a minute. In flight it is completely disengaged and has no connection whatsoever with the rotation of the blades. A simple braking arrangement similar to the familiar wheel brake stops the movement of the rotor after the Autogiro has landed.

In some of the new machines built by Cierva, the tail itself is made to act as a self-starter. The tail is raised, the slip-stream of the propeller is deflected upwards and the rotary blades are forced in turn to a flapping movement which is transformed by aerodynamic reaction into circular motion.

Two small fixed wings with upturned wing tips provide lateral stability and serve also the purpose of carrying the ailerons and for providing a convenient mounting for the wide under-carriage.

In the 13½ foot spread of this unusual landing gear, a novel arrangement of streamlined wires in tension and cabane struts in compression is used. The struts transmit landing loads to the base of the triangular stub axles to which the wheels are attached and landing stresses, after being transmitted through oleo-pneumatic shock struts, are taken through the heavy wires in tension to the bottom of the cabane struts. Although the appearance of this under-carriage is that of great strength, it is nevertheless designed for 25 percent less loading than would be necessary with an airplane of equivalent weight.

The Future: Some Opinions

OPINION as to the future of the Autogiro is still very divided among experts. But the Autogiro has made many friends among unprejudiced aeronautical men. Captain Richard Depew, a noted pilot and connected with the Fairchild Airplane

A close-up of the doubly articulated blade system, the starter drive, and supporting "droop" cables

Manufacturing Company has put himself on record as follows:

"It is my opinion that the Autogiro can be flown by any reasonably good pilot without any difficulty whatsoever. Furthermore I believe that a novice could learn to fly the Autogiro more easily than an airplane. . . . My impression is that the Autogiro can do anything reasonable that an airplane can do, plus a great deal more than any airplane can do in the way of flying and descending at very low air speeds. To an airplane pilot, it is a great thrill to sit in the Autogiro and almost hover over a spot at ridiculously low air speeds, and still have the machine climbing under perfect control. The ease of controlling and the responsiveness of the controls at exceedingly low speeds are astonishing to one accustomed to flying an airplane."

Thomas A. Edison at the Newark Airport is reported to have said, "That's the answer, that's the answer."

Thomas Carrol, formerly chief test pilot for the N. A. C. A. has also an encouraging view: "Development of all mediums of mechanical transport has always waited upon the invention of devices that could successfully check and control the great speeds of which they were potentially capable. Railroad trains could travel at high speeds long before commercial train schedules reflected those speeds. The Westinghouse Air Brake made possible the safe speeds now attained on the railroads. Four-wheel brakes have done much the same for the motor car. The Autogiro is the first heavier-than-air craft to embody in its design this ability to check its own speed. Incidentally this one factor gives an amazing sense of security while flying this machine."

Our own view would be that the Autogiro will not supplant the exceedingly fast and efficient transport airplane, but that it will nevertheless occupy a definite place in the general plan of heavier-than-air flying, and that it may have extraordinary possibilities of usefulness in the realm of private flying. The skill, energy and perseverance of Cierva himself, of Harold Pitcairn and his engineer Larsen, of Kellett, Le Page, and MacClarren, associated in another American group, are guaranteed that nothing technical or experimental will be left undone to secure the ultimate possibilities of the Autogiro.—A. K.

Crashes Due to Vapor Locks

ONE of the commonest causes of accident is failure of the engine immediately after the airplane leaves the ground. Such accidents have been known to occur when the plane and the engine were in perfect condition before the start of the flight, and when both ground and flying personnel had the best possible qualifications.

In several instances, the subsequent investigation showed that the dual ignition of the engine was in perfect condition and could not possibly be blamed. The carbureters were of the two or three jet type and were in no way clogged. The tanks contained ample gasoline. The valves, gearing, and other mechanical parts of the engine were functioning perfectly. The engines had been tested at full throttle prior to the take-off.

Wherein then lay the cause of the mysterious failure of the power plant?

Mr. E. Curran, writing in *Aviation Engineering*, seems to have solved the mystery of these extraordinary and unpleasant failures. An investigation of eight forced landings immediately after the take-off showed that there was one common feature in all the cases involved: namely, gravity feed with a tank placed in the wing with a comparatively long pipe from the wing tank to the carbureter and a shut-off cock situated near the tank.

Mr. Curran diagnosed the trouble as follows: When the shut-off cock is closed on landing, the pipe from the wing tank to the carbureter is emptied of gasoline and is filled with air or vapor. When the cock is open, the gasoline in the tank does not immediately expel the air or gasoline vapor in the long pipe. The presence of this air or vapor retards the flow of gasoline in an otherwise perfectly satisfactory system. Therefore soon after the plane leaves the ground insufficient fuel is fed to the carbureter, the engine fails, and the plane has to make a forced landing. This conclusion has been checked by systematic and careful test.

The remedy is simple. The shut-off cock should be placed as near as possible to the carbureter. In this way the long gasoline line is always full of fuel and the danger of vapor lock or retardation of flow is removed.

Airplane designers have spent a great deal of time and ingenuity in avoiding difficulties due to engine failure on the climb. Here is a simple idea which is likely to eliminate such cause of accident in a great measure. This bears out once again our opinion that the safety of the airplane is not merely a question of stability or aerodynamics but also of care and thought in a multiplicity of small details.—*A. K.*

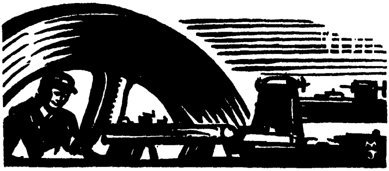
Modern Metallurgy and Cosmetics of Ancients

IT has more than once been alleged, says *Chemical Age*, that it was to the use of cosmetics of mineral origin that, in prehistoric times, the discovery of the art of smelting metals was due. The legend runs that some irate husband in the distant past made a bonfire of his wife's "beauty box" and thereby reduced its metallic contents "in contact with carbon" with the result that metal products were subsequently discovered amongst the ashes of the connubial hearth.

The use of mineral powders as toilet adjuncts is, of course, extremely ancient, and color is lent to the hoary legend by some recent discoveries made by Professor Dart, of the Witwatersrand University in Northern Rhodesia. Near Broken Hill there was found the remains of an ancient manganese mine, the first of its kind to be discovered, and it can hardly be imagined that the deposits were worked for their metallurgical value.

Dr. Dart tells us, as other scientists have told us before, that manganese, in the form of the black crystalline pyrolusite, was used for dusting the hair, in ancient times, just as red ochre was used for imparting the fashionable tint to the skin,

The mounting of the blades on their pylon above the fuselage.



Hammering Hardens Steel, But Plays Havoc With Putty

WHO buy in 1931 and who will buy? The hammer of business stress for the past year has struck impartially against every business organization, assailing both the weak and the strong. The weak have been squashed like putty; the strong have been hardened like steel.

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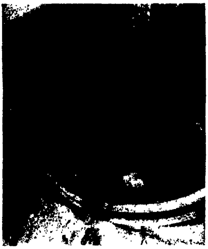
and powdered green malachite was used, mixed with unguents, for painting the eyelids. To this list may be added antimony compounds, such as the sulfide, used as a depilatory, while many other instances will occur to those familiar with the composition of the cosmetics of the modern beauty shop. It may well be that to the accidental or purposeful burning of some of these that the origin of the art of metallurgy in ancient times is to be ascribed.—*A. E. B.*



A screen in a gravel plant armored with tough lining of rubber

Diet and the Teeth

SKULLS of ancient Egyptians reveal the same type of decay of the teeth that is seen in modern individuals. For many years it has been believed that the appearance of dental decay is associated with general ill health. The pathologists who have studied the condition believe that caries of the teeth are due to the dissolving of the mineral salts of the teeth in certain areas. This breaking down has been alleged to be caused by the actions of bacteria, by changes in the chemistry of the saliva, by disturbances of the glands of internal secretion, and by a bad diet. In most instances, the dental decay occurs between the ages of seven and twenty. Quite recently investigators in the University of Wisconsin noted that the prevalence of dental decay was much less among children given adequate diets than in those that were on deficient diets.

Drs. Bunting, Hadley, Jay, and Hard therefore determined to compare the relative influences of antiseptic mouth washes, varied diets, and combinations of these. The people studied lived in institutions supported by the state and could therefore be quite satisfactorily followed. In two groups a satisfactory diet was used, except for the elimination of sugar. In these diets milk, green vegetables, and fruit were prominent. Moreover, an antiseptic mouth wash was used daily. At the end of the period of observation, caries was found to be active in approximately 5 percent, while 80 percent were relatively free from the disorder.

In a third group, antiseptics were used in the mouth, but control of the diet was not attempted. After nine months, 50 percent had caries and only 25 percent were free. In the fourth group the diet was good but not ideal and the mouth wash was omitted. After a year 75 percent were normal and only 6 percent showed active caries. The fifth group had merely an ordinary diet with no attempt to provide the essentials and no attempt to carry out mouth antisepsis. In this group, 18 percent were free, while 49 percent showed active caries.

The general impression from these studies is that diet is of far more importance than any other factor in the control of caries. In the three groups in which milk, fruit, and green vegetables were prominent, progress of dental decay was either greatly diminished or entirely prevented, and these results were obtained whether antiseptic mouth washes were used or not. It is, of course, quite possible that the effect of the improved diets was due to mechanical action in chewing as much as to any change in the general chemistry of the body. This point merits further study.—*M. F.*

Rubber Armor Protects Steel

WHEN the rubber chemists of the B. F. Goodrich Company discovered a method for attaching a rubber lining to a metal surface, they presented a new and valuable material to the chemical engineer for use in the vats, tanks, pipes, pumps, and so forth, in which he handles corrosive liquids. The rubber lining effectively resists the action of acids which would soon eat through the steel. Now this process of attaching a rubber surface to metal has been perfected to a degree which encourages its use to resist abrasion in some of the most severe service conditions imaginable.

One of our photographs shows the exit end of a large screen used in a gravel plant. The sharp rocks would soon wear away the rotating steel cylinder, but since it has been lined with rubber, the wear is seemingly negligible.

Another illustration shows an application of rubber to the chutes and baffle plates of a big dredge. The residents of Edgewood formerly complained about the noise the dredges made, so it was on the baffles that rubber was first used. The rubber-covered baffle plates last about a year. A steel plate usually lasts five or six weeks. The part of the chute extending up into the air has been in service about three years and the rubber looks as good as new. However, it isn't used as much as the first section. The first section, down which gravel is rolling lasts a year as compared with five or six weeks for bare steel lining.—*A. E. B.*

Copper in Oyster Farming

THERE is no more important event in the life history of the oyster or in the successful operation of oyster farming than that which marks the attachment or cementing of the microscopic larval oyster to submerged objects such as old shells, gravel, and brush.

This process of attachment or setting, which must be successfully completed for the survival of the oyster, has been found to depend upon the presence of an infinitesimal amount of copper in the water.

Setting has been produced in solutions containing as little as one part copper to 50,000,000 parts of sea water and proceeds with greater rapidity as the salinity of the water is decreased. The beneficial and stimulative value of minute amounts of copper must not, however, be construed to indicate that trade wastes containing this metal are helpful in the least, as the greater amount which they contain has been found to have a poisonous effect on the larvae, causing death in a very short time. It is also apparent that trade wastes of an alkaline character would precipitate from the river water its normal content of copper and thus deprive the oyster of this essential element for setting and transformation into the adult stage.

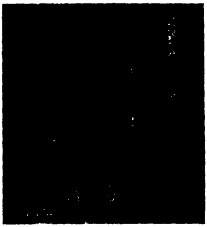
In an effort to find some chemical which would be effective and at the same time practical for the elimination of starfish from the oyster beds, copper sulfate has been found to meet the requirements. This substance may be dragged over the beds in bags at the beginning of flood tide and as little as 15 ounces in 2000 gallons of water will kill the adult starfish upon exposure of only a few minutes. Small starfish are

Rubber covered baffle plates which last about a year replace steel plate baffles which last only five or six weeks at the end of these gravel chutes of dredges.

killed by exposure to solutions of 12 to 16 ounces in 10,000 gallons of water. The interesting feature of this poison is that it is not toxic to oysters or marine fish and is soon precipitated entirely out of the sea water.—H. F. PRYTHERCH, in *The United States Daily.*

Control of Condensation on Factory Walls

CONDENSED water from walls, ceilings, and windows always carries with it material of a damaging character. Practically no factory work room can be kept in such a high state of cleanliness that the condensed water which may drop from these surfaces is clean and undefiled. Relatively high humidity which leads to condensation of water on walls is created as a result of processes of manufacture such as are found in dye houses, laundries, pulp mills, and so forth.



There are two effective ways of preventing such condensation—by increasing the temperatures of the surfaces where the condensation takes place, and by controlling the moisture content of the air. An excellent and not too expensive method to prevent condensation is shown in the accompanying photograph. In this system ventilating pipes carry moderately hot air blasts to the pilasters between windows and also to the skylight where condensation is usually most serious and from which the drip is likely to be directly upon materials in process of manufacture.

Aluminum Cooking Utensils

PERSISTENT assertions that the use of aluminum cooking utensils is injurious to health caused the federal bureau of health in Germany to conduct a careful inquiry. Experiments were made on animals extending over many months and human beings were tested with comparatively large doses of aluminum. In none of these were any serious disturbances of health noted.

It was found that the metal contained in the compound does not enter the body fluid by the intestines, but is carried off with the excretions. In more than a year of experimentation it was found that the amount of aluminum in the blood, the urine, the gans, and the tissues was merely the usual

DISCOVERIES
IN
LIGHT RAYS

Presenting the story of "selective irradiation"

a new development in foods

This scientific discovery was made in the Basic Science Research Laboratory of the University of Cincinnati. Its utilization by the public in food and other products will be made possible through an alliance between General Foods Corporation and the University of Cincinnati, to be known as General Development Laboratories, Inc.

Applications of the new discovery indicate far-reaching effects in the food industry. It can be used to add Vitamin D in definitely controllable quantities to many food and pharmaceutical products. It can be used for sterilization in the prevention of food spoilage. Organisms causing fermentation, yeast moulds and similar foes to preservation of foods yield to the new light treatment methods.

The detailed story of "selective irradiation"—its discovery, its application, its possibilities—is told in a booklet just published, "New Discoveries in Light Rays." We believe this booklet will be of interest not only to the food industry, but also to the public generally. It will be sent to any interested person free upon request.

Write to General Foods *Corporation*

DEPARTMENT 2-F

250 PARK AVENUE NEW YORK CITY

Maxwell House Coffee and Tea, Log Cabin Syrup, Jell-O, Certo, Post's Bran Flakes, Whole Bran, Minute Tapioca, Instant Postum, Hellmann's Mayonnaise Products, Walter Baker's Chocolate and Cocoa, Franklin Baker's Coconut, Calumet Baking Powder, Grape Nuts, Sanka Coffee, Swans Down Cake Flour, Postum Cereal, Post Toasties, La France, Satina, Diamond Crystal Salt, Jell-O Ice Cream Powder

amount, regardless of the fact that increased amounts of aluminum were taken into the body. These studies confirmed the original investigations made in 1893.

In the United States a determined campaign has been carried on largely by commercial interests to discredit the use of aluminum cooking utensils. The charge has been made that aluminum received in the body in this way is the cause of cancer and of all sorts of gastro-intestinal disturbances. The new investigation is proof again of the utter baselessness of such charges.—*M. F.*

The two trucks of the dustless ash handling system described here. The one in the rear contains the air filters and the motor which creates a vacuum

Paint Metal in the Afternoon

IF you're planning to do any painting on metal surfaces, exposed to the weather, wait until afternoon. That is the advice of Mr. Ulick R. Evans, of Cambridge University, who recently addressed the Society of Chemical Industry. The rusting of iron, he said, is not a direct oxidization process; indeed, the invisible oxide film produced by the direct action of air on stainless steel protects it against corrosion. On ordinary steel the corresponding invisible film gives no protection, unless an oxidizing agent is present to repair the skin as soon as a break-down occurs. That is why red lead is used on structural steel.

In the absence of such substances, steel corrodes when wet. Electric currents pass between the anodic places where the skin is in bad repair, and the cathodic places where it is in good repair. Most paint vehicles, whether linseed oil or nitrocellulose, absorb some water, and unless the lowest coat includes some anti-corrosive substance, attack occurs when the painted iron or steel is wetted.

At Cambridge and other places they have demonstrated that paint applied in the afternoon wears far better than painting done at sunrise, which had shut in an invisible moisture film usually present early in the day. Salt, if shut in under paint, as at a seaside place, draws in water and causes rapid failure.—*A. E. B.*

Dustless Ash Handling

IN these days when there is so much talk about the injurious effects of dust and noise on the populations of our larger cities, the news of a new and entirely practical method of removing ashes noiselessly and dustlessly will be hailed by all.

No longer will it be necessary for unsightly ash-cans to appear on the sidewalks of our cities; and the clouds of dust and ashes scattered over our streets, to say nothing of passing pedestrians and automobiles, may now be a thing of the past.

There may now be seen in New York City a new and patented system which, by means of a powerful suction, carries the ashes from the basements of buildings through a hose or pipe line directly to an air-tight steel receptacle mounted on a motor truck for carting away. The passing pedestrian would not even know that ashes were being collected if the operation of the system were not explained to him.

Even when fully loaded no ashes can be blown from the truck as it passes through the streets because the ashes are contained in an hermetically sealed tank.

The ash handling system above referred to has been developed by Mr. F. C. Allen, Jr., a pneumatic engineer, at 452 Lexington Avenue, New York City, under a basic patent controlled by Mr. Charles L. Tolford. Mr. Allen is President of the Allen Air Appliance Company, Inc.

The apparatus involves the use of two motor trucks. On one is mounted a 75 horsepower Continental motor operating a multi-stage "Triple-A" vacuum producer, together with two large dust filters.

On the other truck is mounted a large steel receptacle into which the ashes are drawn. This is known as the "ash dump unit" while the truck containing the engine and vacuum producer is known as the "power unit."

When filled with ashes, the ash dump unit is driven away to the point where the ashes are to be dumped and another empty ash dump unit takes its place, so that there is no loss of time and the system is in constant operation with the power unit going from one building to another.

Where the system is to be permanently used a pipe line is installed extending from the ash pit to the sidewalk. When ashes are to be removed, the truck therefore makes a quick connection to the pipe line at the sidewalk level and the ashes are drawn up into the truck at a rapid rate, it being possible by the method to load ashes at the rate of one ash-can every 30 seconds.

Bleaching of Paper Pulp Accelerated by Irradiation

A SWEDISH chemist, H. E. Wahlberg, has found that the chemical process of bleaching vegetable fibers with chlorine or hypochlorite for the manufacture of paper is furthered very substantially by being carried out under ultra-violet light. The direct bleaching effect of the light plays an unimportant part. The effect of the irradiation is almost exclusively of a catalytic nature.

If the bleaching liquid is irradiated alone, it will be decomposed; however, if the liquid immediately after the irradiation is brought into contact with bleachable materials, the bleaching will take place a little more quickly. A slight increase in the rate of bleaching can be observed if the bleachable materials are irradiated before the treatment. A surprisingly high effect is obtained, however, when the bleaching liquid and the materials are irradiated jointly during the bleaching process. The effect is increased further by a high concentration of the bleaching substance.

The advantages of this procedure are that the time required for complete bleaching can be considerably reduced and at the same time the process can be carried out at a lower temperature.—*A. E. B.*

Rheumatic Nodules

PEOPLE with chronic rheumatism not infrequently develop nodules under the skin. These nodules are conceived by many investigators as being one of the most im-

The ash dump unit which, when filled with ashes, is driven away to the dumping ground. Another dump unit takes its place so there is no loss of time.

portant signs in this disease. They have been described over many centuries. Apparently some 20 percent of people with chronic arthritis have nodules of this character. They are usually associated with rheumatic fever, most frequently seen on the back of the forearm but also on the

Subcutaneous nodules in rheumatic arthritis. Note the typical "rheumatoid" deformity of hand at right

hands, knees, and scalp. The nodules develop slowly and last for several years, although they may come and go within a period of a few months. Seldom do they cause any inconvenience, except the noyance of their presence.—*M. F.*

Photographic Films of the Andrée Expedition

AFTER 33 years without the slightest knowledge of the fate of Salomon August Andrée's expedition which attempted to reach the North Pole in a balloon, the world was thrilled and shocked last Au-

White Island. Their balloon had landed on the ice July 14, 1897 and the expedition had wandered for weeks before finally succumbing to the rigors of the Arctic.

The fact that undeveloped photographic

were later developed into recognizable pictures, thus giving the world visual evidence of the hardships suffered by the expedition, will surprise most people who realize the necessity, even today, of having films developed within a year or two after their purchase. The Andrée films were enclosed in copper containers but were thoroughly water-soaked nevertheless. It was only recently learned that they were manufactured by the Eastman Kodak Company, of Rochester, New York. Late in October the Kodak Company received word that the negatives had been developed, with successful results, by Professor Hertzberg, a Swedish photographic scientist.

The Arctic temperatures at which the film remained while it waited 33 years for discovery and development are understood to be largely responsible for the preservation of the pictures, since it is known that cold retards chemical action within film, provided that humidity is low. The Andrée material, produced about eight years after the company had begun to market transparent film, was manufactured at a time when [illegible] its to yield large quantities of film of uniform quality were at their height.

In [illegible], according to the Eastman Kodak

We can Count your Chickens before they're Hatched

A CUSTOMER of ours builds incubators. Not kerosene-burning Suburban Heights models, but titanic steam-heated steel hens capable of incubating up to 300,000 eggs in one set—mass production chick factories that turn out seven or eight capacity hatchings in a season. In these huge incubators the whole trick is maintaining a constant circulation of air at 104° F.—and that's where we come in. It's done with fans, as many as 60 sixteen-inch built-in R & M Fans in one battery, and no ordinary fans either, for there's a difficulty you'd never imagine. *Down!* The soft loose silky down of newly-hatched chicks that sifts into ordinary fan-motor bearings and grinds them to pieces like emery. One fan failure would mean several thousand spoiled eggs—*no small loss*. But in all the years these giant hatcheries have been operating with heat-proof, *down-proof* R & M Fans, their only production failures have been traceable to bungled barnyard biology.

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FANS, MOTORS, HAND AND ELECTRIC HOISTS AND CRANES

Company's records, the 100,000th Kodak was made and film and photographic paper were being manufactured at the rate of between 300 and 400 miles monthly. Film base, at that time, was still made by pouring the fluid nitrocellulose "dope" onto long glass tables to dry. It was not for several years that the continuous drum system for manufacturing the emulsion support, now in use at Kodak Park, was made practicable. Although the latter method improved the uniformity of the film base, the company, by the time the Andrée film was manufactured, had advanced the art of making sensitive emulsions to a high plane.

Recovery of Andrée's pictures increased the similarity of the discovery of Andrée's party to that of Scott, the British officer who reached the South Pole in 1913 only to perish with his companions in a blizzard that obstructed his return. Photographic film, also made by the Eastman Kodak Company, and developed the better part of a year after the death of the British party gave the world a posthumous photographic record of that expedition's struggles.

Unique Sulfur Mining Process

ENORMOUS quantities of sulfur exist in the earth's crust. It has been estimated that sulfur constitutes .06 to 1 percent, but a large part of the world reserves can not be estimated with precision. Such estimates vary from 56,000,000 to 121,000,000 metric tons, according to the United States Bureau of Mines.

The Texas Gulf Sulfur Company is the world's largest producer of sulfur. Second largest is The Texas Corporation. These two companies produced 2,363,389 long tons last year—nearly 80 percent of the world production. The accompanying photographs show some of the interesting operations of these companies.

Sulfur is mined by forcing superheated water down into wells where the hot water melts the sulfur so the liquid can be pumped to the surface. A six-inch pipe line carries the hot water down to the sulfur beds; inside this pipe is a three-inch line through which the sulfur rises to the surface; inside the three-inch pipe is a one-inch pipe which carries compressed air at 500 pounds pressure which forces the sulfur up to the storage vats. It is then poured out into a "vat" with wooden sides where it solidifies as it cools. A few inches each day is added to the surface of the "vat" until the block of solid sulfur is about 40 feet high. The wooden sides are then torn away, leaving a great block of the yellow sulfur, from which shipments are blasted as required.—*A. E. B.*

Asphalt-Aluminum Paint

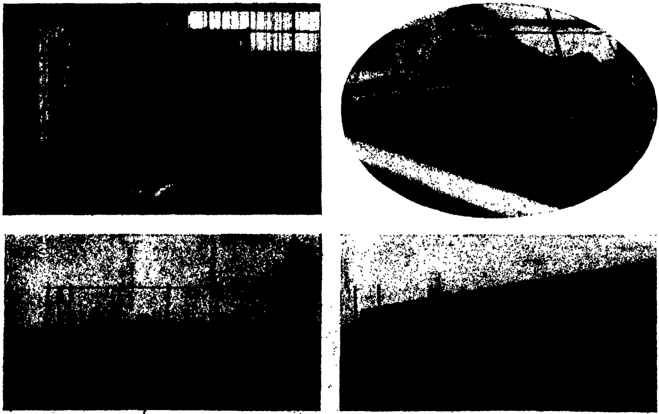
ASPHALT dispersed in a volatile solvent, plus flake aluminum, constitutes a new asphalt-base paint recently put on the market. The flake aluminum is prepared by stamping after which it is polished. A thin film of solvent-repelling polishing agent, which remains on the aluminum flakes, causes them to work their way to the outer surface of the applied coating before the asphalt begins to harden. The finish is, therefore, bright and highly reflecting, having at the same time great covering power and long life, according to the manufacturers.

It is claimed that one coat of this material ordinarily will suffice, regardless of the previous color of the wood, metal, or other material to which the paint is applied. The material is also said to be very efficient as a priming coat for other paints. It is recommended for both interior and exterior work and is said to be particularly effective in reducing evaporation from metal tanks, due to its reflectivity. Its resistance against corrosive atmospheres is said to be excellent. —*A. E. B.*

Cosmic Rays and Cancer

SO great is the field of cancer and we have so little actual knowledge as to its causation that almost any one's suggestion may be given a certain amount of credence. In an editorial in the newly established *American Journal of Cancer*, Dr. Francis Carter Wood has some interesting remarks on cosmic rays and cancer. He points out that sometimes a banker's views on medicine or art afford an evening's delight to the initiated, but that sometimes the productions of a scientist's imagination bring to mind the famous moon hoax of the New York *Sun*.

Prof. John Joly of Trinity College, Dublin, suggested in June, 1930, that a diminution in the strength of the cosmic rays may have something to do with the increased rate in cancer. The cosmic rays have been thoroughly investigated. They come to the earth from a great distance, and they resemble X rays and gamma rays of radium in that they can penetrate thick layers of matter without losing much of their energy. In this regard they are the most powerful rays known, for, after passing through 200 feet of water, 2 percent remain. Millikan estimates their energy to be about one tenth of that reaching the earth from the light radiation of stars. Professor Joly's notion is that these cosmic rays cause increase in cancer because



Water is superheated in the Cochrane jet heaters at upper left and forced into the ground where it melts the sulfur. The upper right picture shows molten sulfur pouring into a vat after being forced to the surface. *Lower left:* On top of a vat of solidified sulfur. *Lower right:* Another vat, which contained 650,000 tons of sulfur, after walls had been torn down they are diminishing at present and that formerly they were sufficient in amount to exert a controlling influence on cancer growth.

In the November number of *Forum*, Professor Joly went much further. He assumes that an enormous increase in cancer has taken place, that cosmic rays in the past may have had destructive effects on cancer, and similar extraordinary assumptions.

Doctor Wood points out that any radiation which would have the slightest effect on a cancer cell would also affect the rest of the body by destroying all the white cells of the blood which are more sensitive to radiation than any cancer cell. The fact that the population of the world has increased steadily indicates that such rays could probably never have been very powerful since man's beginning on earth. Furthermore, statisticians know that the recorded increase in cancer is nearly, if not entirely, due to the improved diagnosis of the internal types of cancer. Most of the increase in cancer is in the form of cancer of the internal organs and in older people. Cancer is essentially a disease of old age and there are many more old people now than there used to be.

Hence it is not at all necessary to consider seriously the suggestions of Professor Joly. The pity is merely that a man of his scientific position in the field of geology should cast discredit on that field by venturing an extraordinary hypothesis in a field in which he has no standing. If Oliver Lodge had avoided spiritualism, and if other authorities in their own fields would let scientific medicine alone, the practitioners of that art and science would be enabled to avoid much of the wastage of time they now

] theories.—*M. F.*

Exercise in Disease

THE ancient Greeks emphasized a certain amount of exercise for keeping a human being in a healthful condition. Exercise, like every other form of treatment of disease, can be overdone. A special report made to the Council on Physical Therapy of the American Medical Association by Dr. J. S. Coulter and C. O. Molander distinguishes therapeutic exercise, or exercise used in the treatment of disease, from the ordinary exercise that is taken for the improvement of health.

In passive exercise, the patient lies still while the attendant moves the various muscles of the body. The doctors emphasize the fact that the spasm of a muscle during such exercise should be an indication for the operator to stop immediately. One of the chief uses of passive exercise is to restore motion to limbs that have contracted. For this purpose, it is pointed out that one movement of the limb through its fullest range is better than a series of movements within a shorter range. By making one or more motions of the limb through its fullest range, it is possible to produce gradually an increase in the range of movement. A dislocated or fractured limb is usually contracted and fixed in position. One of the chief aims of passive motion is to maintain suppleness and in this way to prevent contractures.

However, exercise by passive motion is not the same thing as stretching of a

(*Please turn to page 205*)

A PLAN FOR MEN *who want to*

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THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

"WE got through the grinding, polishing, and figuring without any trouble at all," R. S. Mudge, 856 Park Place, Brooklyn, New York, writes with reference to a telescope made by himself and two others, Joseph Rebold and Raymond Paul, "but the silvering nearly stumped us. We tried it at least a dozen times without success, using grain alcohol; and then we tried rubbing alcohol and hit it the first time."

Mudge-Rebold-Paul telescope

The Mudge-Rebold-Paul telescope is a six-inch and the dingbat attached to it, which shows in the photograph, is an extemporized camera for taking sun photographs.

W. LUTGE, Pinnaroo, South Australia, also had a little trouble but he "got there" just the same. "My telescope," he writes, "has an eight-inch mirror and I ground and polished three mirrors before I succeeded. No. 1 was broken by a fall, No. 2 cracked due to an icy draught when hot. (This is exactly what happened to Brashear on his first job, as told in his autobiography. —*Ed.*) I polished the third mirror on an HCF lap which I found much quicker than the pitch laps I tried first. I found the Foucault test difficult at first but at all times most interesting.

"We have an Astronomical Society in Melbourne and a few of the members are telescope makers. Most Australians, like myself, had considered that making an efficient telescope was outside the scope of the average person. I consider the instruction book 'Amateur Telescope Making' wonderful. I would be willing to help any Australian amateurs who might wish it. My telescope gives beautiful views of the moon, belts of Jupiter, rings of Saturn, and many double stars and star clusters visible in the southern hemisphere."

"THIS is a real alley telescope." So says Henry Kramer, 4338 North Fort Street, Detroit, Michigan, in describing his "coal scuttle" reflector. "But it, too, 'gits thar just the same'," he adds. "There are no details on such maps and photographs of the moon as are in the libraries of Detroit which can [illegible] eight-inch reflector, as crude as the set-up is. The HCF lap is far superior to the pitch lap; it worked faster and was so adaptable that any kind of variation for correction could be had. There was no need of the bootlegger's services, as the rubbing alcohols, Alcorub and Alcol, were all right and silvering was easy. It is just possible that a new planet will be discovered (?) any night now, as we are blazing away with a Kodak trying to make a photo, though no one has profited so far except Mr. Eastman."

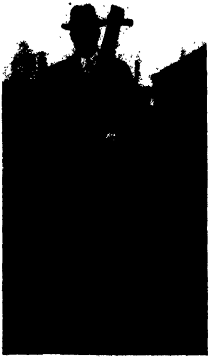
Made in Australia

The Detroit coal-scuttle mounting with its assisted apple-tree pedestal

Mr. Kramer's attachment, a coal scuttle with its bottom knocked out, is for excluding stray light from houses and street lamps, also for discouraging the activities of stray fingers which seem to have a fatal attraction for one's nicely polished mirror.

"AS I live [illegible] nall furnished room, and have no access to tools, I was forced attempt something light, portable, and easy to make." So says John Ortueta, 222 East 11th Street, New York City, who continues: "The telescope shown in the photograph was made mostly with tools and materials bought in the ten-cent stores. It is similar in principle to the one shown in 'Amateur Telescope Making' on page 29. It consists of a mahogany box open at one side, containing the five-inch mirror. When not in use the box stores the prism and eyepieces behind a small lock. The main column is of wood and is jointed and adjustable. The whole thing folds into as small a space as a camera, yet is easy to assemble and weighs less than ten pounds. It is equipped with slow motion and a finder."

C. D. FREEMAN, Care E. P. Maxted, R.4, Caldwell, Idaho, uses his telescope "in connection with a series of lectures on astronomy," and, he adds, "thou-



M. Ortueta and folding reflector

sands of people have had the privilege of looking through it." His mounting is constructed of pipe fittings and the eyepiece is on the polar axis. The mirror is a ten-inch and the rather elongated tube is quite impressive.

WORD has been received from Miami that Professor G. W. Ritchey arrived there from Paris with the Ritchey-Chrétien telescope he expects to use in making a study of the seeing conditions in that locality. With him is G. H. Lutz who has cast a 36-inch Stellite mirror which Professor Ritchey also expects to figure and test. The newspaj

Freeman's long tube mounting

expend large s
the local seeing
Ritchey-Chrétie
Cassegrainian l

WHEN Brother-amateur-telescope-maker Clyde W. Tombaugh, after diligent search, spotted the image of the planet Pluto on a plate at the Lowell Observatory, where his diligence and enthusiasm had won him a job some time previously, there was a certain tendency to minimize his contribution. Some said he merely happened to be the one to look over the plate and it was stated by one astronomer that Tombaugh was no more the discoverer of Pluto than the seaman at the masthead of Columbus' ship was the discoverer of America because he happened to see its shoreline first. Tombaugh's modesty and good taste kept him entirely clear of controversy and now, as so often happens in science, honor pursues him who runs away from it (just as it usually avoids him who runs after it). The Royal Astronomical Society, the association of professional astronomers of Great Britain, has just awarded Tombaugh the Jackson-Gwilt Medal of that society. Other telescope makers who aspire to gold medals may be encouraged by the thought that there are other worlds to conquer, there being no assurance that Pluto is the last planet in the solar system.

ARTIFICIAL SUNLIGHT

By M. LUCKIESH

Director Nela Park Research Laboratories
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All the whys and wherefores of illumination

drawn from the author's extensive practical experience and written for the professional man as well as the intelligent layman. It covers solar and artificial radiation and their physiological effects, measurement, glasses for transmission, in fact the whole subject in full. $3.90 postpaid.

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CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

HOW TO REPAIR AND REFINISH FURNITURE describes the use of a crack filler and a remover for ground-in dirt. *Savogran Company, Boston, Mass.—Gratis.*

DESIGN IN INDUSTRY is a publication giving a digest of new literature relating to the subject. Critical notes and prices are given. *Non-residents of Newark, N. J., are put on the mailing list for 25 cents to cover postage. Newark Public Library, Newark, N. J.*

NICKEL ALLOY STEEL FORGINGS (Nickel Steel Data and Applications No. 17) by Charles McKnight gives the salient facts relating to these important alloy steels. *The International Nickel Co., 67 Wall St., New York, N. Y.—Gratis.*

THE PIPED FUEL BUGABOO (Reprinted from *Railway Age*, Dec. 13, 1930) by C. V. Beck holds that coal is the most economical [illegible] all important coal-consuming areas. *International Carriers, Ltd., 120 Broadway, New York.—Gratis.*

RAILROAD EQUITIES, a survey by John W. Barringer, III, gives much valuable information about natural gas, coal, and fuel oil. The fuel statistics are equated to common bases. *International Carriers, Ltd., 120 Broadway, New York.—Gratis.*

ARCHÆOLOGICAL EXPLORATIONS IN PERU—PART II. THE NORTHERN COAST (Anthropology, Memoirs, Vol. II. No. 2) by A. L. Kroeber describes the first Marshall Field Archæological Expedition to Peru. *Field Museum of Natural History, Chicago, Ill.—$1.50, postage extra.*

ONE MONTH IN SOUTHERN CALIFORNIA AND WHAT WILL IT COST gives a travel program for an entire month. There are also details as to the cost of each day. Certainly breakfasts at 40 cents, luncheons at 50 cents, and dinners at 85 cents sound good. The average expense per day, including sight-seeing, figures out $7.17. *All-Year Club of Southern California, Ltd., 1151 South Broadway, Los Angeles, California.—Gratis.*

CITY NOISE (Report of the Commission appointed by Shirley W. Wynne, Commissioner of Health, to study noise in New York City and to develop means of abating it) by Edward F. Brown, E. B. Dennis, Jr., Jean Henry, and C. Edward Pendray, is a monumental treatise on a most important subject. It is a book of 308 pages which is sent free to interested persons. Address *Edward F. Brown, Director, Noise Abatement Commission, 505 Pearl St., New York.*

M-S-A FIRST AID MATERIALS (Catalogue No. 7A-2) is an excellent catalogue dealing with first aid material put up in very usable form.—*Mine Safety Appliance Co., Pittsburgh, Pa.—Gratis.*

FLORA OF THE YUCATAN (Botanical Series, Field Museum of Natural History, Publication 279, Vol. III) by Paul C. Standley, is a splendid monograph of 492 pages which only a great institution of learning would be justified in publishing.—*Field Museum of Natural History, Chicago, Ill.—$2.00, (postage extra).*

NOTE ON THE ELECTRICAL RESISTANCE OF CONTACTS BETWEEN NUTS AND BOLTS (Research Paper No. 227, Reprint from Bureau of Standards, Journal of Research Vol. 5, September, 1930) by Frank Wenner, G. W. Nusbaum, and B. C. Cruikshanks, describes researches on the electrical conductivity of Dardelet threaded connections. *Dardelet Threadlock Corporation, 120 Broadway, New York.—Gratis.*

GREEK-ROMAN TREASURES OF GERMAN MUSEUMS, edited by Karl Kiesel and Ernest O. Thiele, is a beautifully printed pamphlet giving a complete index of German museums which have notable Greek-Roman treasures. *Terramare Office, Wilhelm-Strasse 23, Berlin S. W. 48, Germany.—Send two International Reply Coupons obtainable at any post office.*

MUSIC IN GERMANY is a delightful little pamphlet giving information as to music centers, music schools, and recent musical literature. It is one of a series of most informing pamphlets on phases of culture in Germany. *Terramare Office, Music Department, Wilhelm-Strasse 23, Berlin, S. W. 48, Germany. Remit two International Reply Coupons which can be obtained at any post office.*

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A MINT IN NEW YORK (Numismatic Notes and Monographs No. 45) by Bauman L. Belden gives an account of why New York did not get a mint but did get an assay office which in time obtained a new building; the old façade is now a part of the American Wing of the Metropolitan Museum. *The American Numismatic Society, Broadway at 156th St., New York, N. Y.—50 cents.*

PARACHUTE SUPPLEMENT, AIR COMMERCE REGULATIONS (Aeronautics Bulletin No. 7-D, United States Department of Commerce, Aeronautics Branch). *U. S. Dept. of Commerce, Aeronautics Branch.—Gratis.*

OUR DEFECTIVE CALENDAR. E. K. Eason of Dublin has written a study of some aspects of the problem, more especially in support of the retention of 12 months in a fixed calendar. *Eason & Son, Ltd., Dublin, Irish Free State.—1 shilling.*

RATE OF GROWTH OF SECOND GROWTH SOUTHERN PINES IN FULL STANDS (Circular 124-C, United States Department of Agriculture) by R. D. Forbes and Daniel Bruce. The authors think that growing new timber is the only way to keep the pine industry of the south from "going back." *Office of Information, U. S. Department of Agriculture, Washington, D. C.—Gratis.*

CALCULATING WATERFOWL ABUNDANCE ON THE BASIS OF BANDING RETURNS (Circular No. 118, United States Department of Agriculture) by Frederick C. Lincoln suggests what seems to be a reliable method of calculating the fluctuations in the numbers of waterfowl. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

RAT PROOFING BUILDINGS AND PREMISES (Farmer's Bulletin No. 1638, U. S. Department of Agriculture) by James Silver, W. E. Crouch, and M. C. Betts gives the best method of rat proofing in structures of all kinds. The diagrams are very clear. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

MINERALS AND INTERNATIONAL RELATIONS (No. 266 of International Conciliation) by Sir Thomas H. Holland, Vice-Chancellor and Principal of the University of Edinburgh deals with the international relationship of minerals and international movement of mineral products in peace and war. *Carnegie Endowment for International Peace, 44 Portland Street, Worcester, Mass.—5 cents.*

GLUING WOOD IN AIRCRAFT MANUFACTURE (Technical Bulletin No. 205, United States Department of Agriculture) by T. R. Truax is an elaborately illustrated monograph which will be of use to any person who uses glue in any form. It gives formulas for glues which are patented but which are for the free use of the people of the United States. *Superintendent of Documents, Washington, D. C.—25 cents (money order).*

THE SCIENTIFIC AMERICAN DIGEST

(Continued from page 201)

contracture or adhesion. The purpose of stretching is to loosen contracted ligaments, muscles, or adhesions. The untrained operator is likely to attempt such stretching before inflammation has subsided. It is well established that stretching should never be attempted until the inflammation around the joint or in the joint has disappeared. In order to stretch a limb that has contracted, it is necessary to pull slowly and steadily with gradually increasing weights. Whenever soreness or pain develops, it is safer to stop the motion and to apply heat and permit resting until the pain and soreness have disappeared. Pain that disappears within an hour after the treatment is usually not serious.

In active exercise the patient himself produces the motion with or without the supervision of the operator. Active motion may involve the use of apparatus, such as pulleys or weights. They may be free motions of the arms or they may be resistive motion, in which the muscles push against resistance of various kinds. Far too often, a patient is told merely to exercise an arm or a leg. Little can be accomplished that is of value by this method. The only way to get proper results is to direct the nature of the exercise toward a definite purpose. It is customary in such cases either for the physician or his assistant to watch the work or else to give written instructions so that it will be carried on in a definite manner.—*M. F.*

FINE-GRAIN SUGAR PRODUCED

IN order to provide granulated sugar that will dissolve quickly in iced drinks, sugar refiners have experimented with various methods of reducing the grain size. The latest method of attaining this fine grain sugar, known as the Varnau-Wayne process, is now in commercial operation in Texas.

The new process is a radical departure from customary practice for finely granulated sugar. It starts with a syrup of much lower density. A practically grain-free syrup is obtained by evaporating in a series of vacuum pans and finally in a finishing pan. This concentrated syrup is then chilled suddenly by squirting it as a mist or thin film into an air or vacuum chamber, giving an instantaneous super-saturation effect and causing minute crystals to form at once. The method produces a new type of extremely fine-grained sugar, readily soluble, and very pure. The process is continuous and nearly automatic, so that most of the personal factor is eliminated. Thus the product is more uniform than with vacuum-pan methods.

When you buy a two-pound box of this sugar at the store, you may notice that the box is larger than a two-pound box of ordinary granulated sugar. Do not be misled, however, for the difference in size is merely due to the fact that the new type of sugar bulks larger per pound than the old.—*A. E. B.*

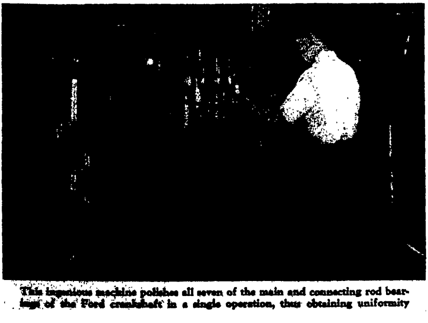
Polishing Seven Bearings In One Operation

BEARINGS of the Ford crankshaft are being polished to a much finer degree as the result of the development of machines that finish all seven main and connecting-rod bearings in a single operation.

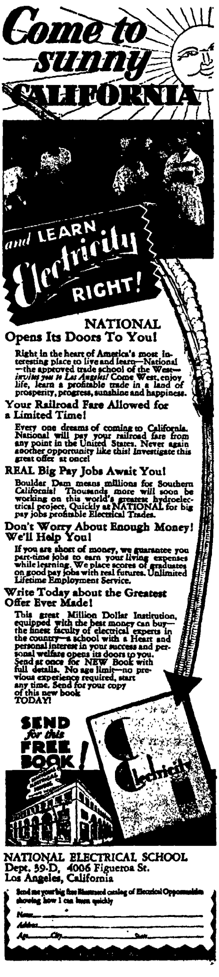
After the crankshaft has received its final grinding and has been statically and dynamically balanced it is placed in a specially built lapping machine which has seven arms—one for each bearing. Each arm holds six very fine lapping stones or hones which clamp around the bearings under heavy pressure. The shaft is rotated and also oscillated until no roughness from the grinding operations remains.

To insure an absolutely smooth and bright finish, the shaft is then placed in a similar machine which holds an extra fine polishing paper instead of the lapping stones. Again it is rotated and oscillated, after which the bearings are cleaned and inspected.

This process gives the bearings a mirror-like smoothness which reduces friction and makes easier the breaking-in period of the car. The polishing paper used in the second machine is fed automatically so that there



This ingenious machine polishes all seven of the main and connecting rod bearings of the Ford crankshaft in a single operation, thus obtaining uniformity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is a fresh supply for each crankshaft. This, with the oscillating motion, permits a more uniform finish than was possible under the old method of polishing each bearing separately on a revolving wheel.

Self-Vulcanizing Rubber Compound

RESURFACING rubberized material, or lining metal equipment with soft rubber is possible with a new rubber compound known as "Covulc," made by the Hitchcock Company, 48 Pearl Street, Boston, Massachusetts. This is a soft, plastic rubber compound made in various colors, which is applied to a surface in the form of a paste, and rapidly vulcanizes itself when exposed to the air. After vulcanizing it is said to remain soft and flexible during its life.

The material is available also in the form of sheets already vulcanized to a fabric or wire-mesh base. In this form, it may be cut to any size desired, for lining chutes and hoppers. Either form is easily applied, according to the manufacturer. For example, in repairing a conveyor belt, the cleaned belt is brushed with a special cleaning fluid and coated with a rubber solution. Then the plastic rubber is applied with a spatula or putty knife and smoothed with a glass roller. The material is reported to [illegible] ufficiently in about three hours, [illegible] under hot and dry conditions [illegible] *E. B.*

A Stationary-Head Engine

A TWO-STROKE gasoline engine that is claimed to eliminate objectionable features of the conventional type of engine, both two-stroke and four-stroke, has been perfected by the Scott Two-Stroke Motor Company, of Kansas City, Missouri.

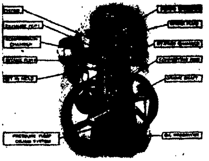
[illegible] which effectively seals the firing [illegible] against leakage of gasoline into [illegible]

the moving piston. The latter is hollow, or rather, it takes the form of a sleeve which slides between the stationary head and the cylinder wall. The motor is termed a piston valve engine because of the port arrangement of the moving piston and the cylinder. It fires with every revolution of the crankshaft.

There are in reality two chambers in the cylinder. The lower chamber inside the hollow piston is the suction and supply chamber while the upper one is the compressing and firing chamber; and both handle gasoline. This unique desig [illegible] crankcase gasoline and crankcase compression or displacement, thus doing away, it is claimed, with the basic faults of two-stroke engine design. It also creates a positive measured action for each charge without leakage or adulteration of fuel.

An accompanying illustration shows clearly the unique piston design, performing function of piston, sleeve, and valve in one moving part. It also shows the elimination of such parts as valves, valve springs, tappets, triggers, rollers, push rods, rocker arms, cam shaft, and cam shaft gears.

It is expected that this motor will be seen



Cut-away drawing of the two-stroke, stationary-head gasoline engine

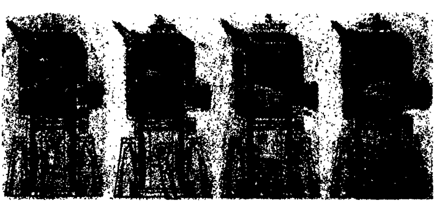
in the air in the very near future. This company has now designed, and is ready to [illegible] cylinder [illegible] use in power gliders. It will be 48 horsepower, air-cooled, and the weight will be 80 pounds. Also, a four-cylinder, 100 horsepower; a six-cylinder, 150 horsepower; and an eight-cylinder, 250 horsepower engine will be made.

The Flow of Milk

THE establishment of the important fact [illegible] ing the [illegible] in which it seems

Careful studies have shown that nervous shock and the emotional states and environment of the mother will affect the flow of milk. It is generally believed that substances secreted into the blood of the mother from various glandular organs stimulate the enlargement of the breast and the flow of milk, but the evidence is contradictory and certainly not conclusive.

Studies recently made by Icie Macy and her colleagues in the Children's Hospital in Detroit seem to indicate that suckling by



The cycle of operation of the stationary-head engine described above the child is not necessary for the stimulation and continuance of heavy milk flow in women, since frequent and thorough stripping of the breast by hand or by the use of pumping devices brings about a ready and large flow of milk. An instance is known in which a woman produced as much as six quarts of milk in one day and was able to nurse from one to seven babies for a period of 51 weeks. In the cases of the mothers tested in Detroit, the average daily output of milk from the sixth week through the 14th month was two and one half quarts a day. One mother produced three quarts, another two and one half, and another only one and one half. Apparently the removal of the milk from the breast encourages secretion, whereas accumulation of the milk discourages it.—*M. F.*

CHEMICAL CAULKING FOR CONCRETE OR MASONRY

THERE has recently been developed, in Germany, a chemical process for caulk- [illegible] engthen [illegible] strengthened. The rock, masonry, or concrete is first impregnated with silicic acid solution. The second solution is then sprayed into it, causing a chemical reaction. This procedure is more advantageous than proofing with cement slurry, since the solutions enter into the finest pores and hair-like cracks of the structure to be proofed. It can be applied to any depth, the solutions being [illegible] 'ed pressure. It [illegible] ported that this treatment has been successful in preventing the inflow of water in mine shafts and in strengthening masonry loosened by the action of the water.—*A. E. B.*

Electrolytic Metal Cleaning

A NEW and promising process for cleaning metal surfaces by electrolysis has been patented recently and is said to be free from the disadvantages heretofore associated with electrochemical cleaning—to be cleaned the instant each particle of scale is removed. So that the metal may be completely protected from attack by the bath, the film is itself a metal, resistant to the bath, such as lead, tin, or zinc.

The process is extremely simple in operation. Equipment includes two steam-heated, ventilated tanks, and two wash tanks. The acid tank is lined with lead or rubber and the caustic tank is made of iron. Anodes are made of whatever metal—as, for example, lead—is to be used for the protective film; or if metal salts are to be added directly to the bath, the anodes are of carbon. The cathodes in any case are the objects to be cleaned. The current supply is six volts direct current.

Solution for an acid bath using lead anodes contains a few ounces each of sulfuric acid, hydrochloric acid, and common salt per gallon of water. The caustic solution [illegible] ll quantity of tri-sodium phosphate, soda ash, and caustic soda. The a[illegible] bath is operated at about 150 de[illegible], and the caustic bath at about 200 degre[illegible]

covered [illegible] scale, it is first suspended as the cathode in the caustic tank. Between the action of the solution and the electrolytically released hydrogen, which evolves on the metal surface, the dirt is very quickly removed. After a hot water wash, the piece is suspended as the cathode in the acid tank, where, assuming that the protecting film is to be lead, action is roughly as follows:

Ionic hydrogen, [illegible]

the cathode and, losing its charge in contact with the metal underneath the oxide scale, is evolved in minute bubbles of molecular hydrogen. The hydrogen, in expanding, pries off the scale, bit by bit, and bubbles to the surface. And as soon as any bit of metal is exposed, lead-ion deposits on it as a thin, adherent, protective film.

This prying and coating action goes on continuously until all of the scale has been removed. All of the action is very rapid and takes ordinarily only a few minutes even for a large object. The several advantages of the process, such as complete protection for the parts treated, excellent cleaning even in such hard-to-get-at places as the roots of threads, its low cost of operation, and its foolproof character, would seem to make it a most attractive possibility for many metal industries.—*A. E. B.*

Greasy, rusty, scaly metal parts are made "good as new" electrolytically

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OUR POINT OF VIEW

(Continued from page 157)

among the Hindu and Moslem delegates and the willingness of the Princes of the independent Indian States to join the proposed federation, brought about the agreement.

After the tentative agreement is legalized the difficulties of putting these changes into operation in India will be great, and Mr. MacDonald has selected as the successor of Lord Irwin, the present Governor General of Canada, Lord Willingdon. The English press is practically unanimous in approving this selection, and the rest of the world will wish the new Viceroy well, for the removal of the present unrest in India will do much to decrease the present depression in world trade.

Panama Joins the Insurgents

THE Panamanians could not resist the impulse to indulge in the revolutions recently so prevalent in Latin America and have overthrown the government of President Arosemena. During the brief hostilities a few natives were killed and wounded; one American, Mr. H. F. Ayers, a newspaper correspondent, was mortally wounded. There were many indications of dissatisfaction with the Government prior to its overthrow, but few observers believed the insurgents would dare forcibly to overthrow the government in the presence of our army garrisons in the Canal Zone.

We realize the difficult situations that have confronted the State Department in this unprecedented series of Latin American revolutions, and without the complete information in the possession of our Government, we will not express an opinion but we wonder if the time is not at hand when we should at least assist in preserving order in Panama and Cuba.

The Bank of International Settlements

ALREADY the functions of this latest institution in world banking are expanding, and under the able management of its American president, Mr. Gates W. McGarrah, we may expect it to continue to enlarge its field. At present the founder members own stock as follows: Banking groups in the United States and Japan, 8 percent each; Bank of England, Bank of France, Bank of Italy, Bank of Belgium, and the Reich Bank, 8 percent each; and they elect 16 of the 25 directors. These members have allotted 2 percent of stock to banks, mostly state banks, in each of the following states: Holland, Sweden, Switzerland, Denmark, Austria, Hungary, Poland, Czechoslovakia, Rumania, Greece, Bulgaria, Finland, and Danzig, their interests being represented by nine directors. The remaining 18 percent of stock will be issued to states like Spain and Jugoslavia when they put their banking and currency systems in order, and request to join.

The capital stock is only 20,000,000 dollars, yet on December 1, 1930, its resources were over 360,000,000 dollars. The bank has been extremely conservative in investing its resources so that they can be quickly liquidated.

In addition to acting as Trustee of Reparations, the bank has endeavored to assist Germany in her recent financial crisis by purchasing reichmarks; and has made certain advances to Eastern states whose interest rates were considered excessive. The bank endeavors to level out rates of exchange between various states by transferring capital from markets of low interest to those of high interest.

The bank authorities are now considering whether it shall be made a clearing house for private international payments. Unquestionably that would be a useful and profitable international banking function, but such action would almost certainly cut into the profits of national banks specializing in foreign exchange, create jealousy, and perhaps lead to its eventual abolition. As stated previously in these columns, we believe this bank is destined to be an extremely useful agent for international trade, unless it is choked in its infancy by jealous national banks or extinguished in some future world war, before provision can be made for its preservation. The fostering parents of this promising infant should not develop it too rapidly, or selfish and short-sighted financial interests may strangle it.

China—Customs—Abolition of "Likin"

THE world powers only recently granted China a measure of control over her import duties on condition that "Likin," the tax levied by Chinese provincial authorities on goods as they pass from province to province, be abolished. At least two provinces, one of them Shantung, is continuing the old interior tax in addition to the increased customs paid at the seaports.

The Nanking Government is unable to prevent these local imposts, largely because it is financially unable to maintain an adequate army to enforce its edicts. The long-continued refusal of the world powers to permit import taxes sufficient to support the central government is one of the fundamental causes of the present condition.

President Chiang Kai-shek and Marshal Chang Hsueh-Liang, over-lord of Manchuria, are apparently still working together, and their co-operation continues to be the brightest hope of China. Marshal Chang needs 20,000,000 Mexican dollars, to equip his army and rehabilitate North China. Finance Minister Soong has not yet approved the flotation of this loan. If some assurance could be given that the money would be honestly and efficiently expended, this loan could easily be obtained in Canada, the United Kingdom, or the United States. The authority of the Nanking Government could be gradually extended into the interior with the well equipped army that the loan would make possible; and probably order could be restored in China. As the desire of the great powers to retain China as a dumping ground for their surplus manufactures was one of the fundamental causes of the continued weakness of the Central Government, they should be willing to take some financial risks in an effort to rehabilitate China. Desperate situations require desperate remedies, and only strong and helpful measures can improve the conditions in China. We have long been a disinterested friend of China. We should support the measures suggested by Senator Pittman and Premier Bennett, and in doing so we shall probably help ourselves as well as the Chinese.

PROGRESS IN 1930

(Continued from page 167)

M. R. Harrington of the Southwest Museum, and were widely regarded as important evidence regarding early American inhabitants.

The oldest known culture in the world, originated by the so-called "Japhethite" peoples of nearer Asia, was reported by Prof. E. A. Speiser of the University of Pennsylvania.

A temple built by Nebuchadnezzar and
made at Ur of the Chaldees by the expedition of the Uni
sity of Pen
iah Museum.

Meteorological balloons were first used in aerial photography of archeological exca-
s by the Megiddo Expeditic
Oriental Institute clearing the mound of ancient Armageddon in Palestine.

A tomb containing mummies of two Egyptian princesses was examined by the expedition of the Metropolitan Museum of Art, and a fine copy of the Book of the Dead was brought to America.

The greatest collection of Ptolema mummies ever found in one tomb was u earthed in a mastabah, or flat-topped tom structure, at Meydum, the great nation burying ground of the aristocracy of a cient Egypt.

The discovery of a tomb, called the lar
e tomb found in Egypt, was made near the Sphinx at Giza by Prof. Selim Hassan Effendi of the Egyptian University.

A second skull of *Sinanthropus* was recovered from material taken out of the limestone caves at Choukoutien, about 40 miles from where the original "Peking Man" skull was found in 1929.

Astronomy

A new planet, the first to be discovered since 1845, was found photographically with a 13-inch telescope at Lowell Observatory in approximately the place predicted by the late Prof. Percival Lowell, founder of the observatory, who died in 1916. The planet, which is farther from the sun than any other yet discovered, was later named Pluto.

Inter-stellar space, especially in the plane of the Milky Way, is not transparent, but filled with diffuse material that absorbs a considerable amount of light from distant stars, thus making the previous estimates of their distances too large, it was indicated by researches of Dr. R. J. Trumpler, of the Lick Observatory, supported by independent work of Dr. Piet van de Kamp, of the Leander McCormick Observatory.

A faint group of nebulae was found to be apparently speeding away from the earth at the rate of 7200 miles a second, the highest astronomical speed yet recorded, by studies of Dr. Edwin P. Hubble and Milton L. Humason of Mt. Wilson Observatory; but it is supposed that the effect is really an illusion, due to curvature of space.

Many stars are spinning at the rate of 40 miles a second, 150 times the speed of the earth at the equator, it was discovered by a new method developed by Dr. Otto Struve of the Yerkes Observatory in collaboration with a Russian astronomer, Dr. G. Shajn.

An unusually large display of Leonid meteors was visible on the early morning of November 17, suggesting the possibility of a brilliant shower in November 1932, 1933, or 1934.

The theory that stars have a structure similar to that of an egg, a dense yolk in the center, surrounded by a lighter material, was advanced by Prof. E. A. Milne, Oxford University, England.

A new theory of the construction of the universe, that it constitutes a huge system made by the condensation of a loose swarm of smaller clusters of stars which were originally like the mysterious spiral nebulae, was proposed by Dr. Harlow Shapley
Harvard College Obs

The surface of the moon is
overed with volcan
ducted by Dr. B. Lyot
tory indicate

The theory that the earth may ha
et-like
patch of light called by astronomers the "Gegenschein," was advanced by Dr. E. O. Hulburt, of the United States Naval Research Laboratory.

The length of Neptune's day was found by Dr. J. H. Moore of Lick Observa
t 16 hou

A new 50-foot interferometer, a giant instrument for the measurement of the diameter of stars through the interference of reflected light waves, was completed at Mt. Wilson Observatory in California.

Arsenic and germanium are both present in some meteorites that fall to the earth, it was discovered by Dr. Jacob Papish and Zaida M. Hanford, Cornell University chemists.

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observer may at will see a fascimile
heavens as they look at any time ar
any place, was opened on May 10
cago.

The discovery of seven comets
nounced during
not confirmed and another was a return of a periodic visitor. The first and fourth were discovered by Drs. Schwassman and Wachmann, of the Hamburg Observatory, Germany, though the former was independently found by L. C. Peltier, an amateur astronomer of Delphos, Ohio. The second was discovered by Beyer, also at Hamburg; the third by Wilk, of Cracow, Poland; the fifth by D. L. Forbes, of Rondebosch, South Africa; the sixth was the re-discovery of Tempel's second comet by Dr. George van Biesbroeck, of the Yerkes Observatory and the seventh was by Nakamura, of the Kyoto Imperial University, in Japan. Efforts of American astronomers to find Nakamura's comet, which Japanese dispatches said had been observed by Sibata, of the same observatory, were unsuccessful, however.

Chemistry

The existence of rotating molecules in solid compounds was reported by Prof. Linus Pauling, of the California Institute of Technology, and Dr. Sterling B. Hendricks, of the Fixed Nitrogen Laboratory, United States Department of Agriculture; this discovery has an important bearing on the heat capacities of solids.

The chemical puzzle of the structure of the crystal of the silicates was solved by William L. Bragg, Victoria University of Manchester, England, and Professor Linus

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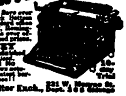

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RELAX!

***Dr. Thurman Rice tells you how in the March* HYGEIA**

A series of articles will be running in HYGEIA for the next four or five months—articles on relaxation and rest. Evidently Dr. Rice believes that the first requisite of relaxation is laughter, for his article abounds with wit and wise-cracks. Oh, yes, in connection with sleep—he actually advises you to eat crackers and milk before you go to bed—so if you are sure your bedtime lunches are ruining your digestion, put your fears to rest. You'll relax in amusement when you read the articles of Dr. Rice. The series starts with "Fatigue" in the March HYGEIA. Along with it will be:—"Are Modern Parents Failures?," "Dietary Advice for the Expectant Mother," a great many other vital articles with three children's health stories.

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Pauling, of the California Institute of Technology.

A new gas for use in electric refrigerators, non-poisonous and non-inflammable, which is a compound of carbon, chlorine, and fluorine, was the invention of Thomas Midgley, Jr.

Carotin, the stuff that makes some foods yellow, is important for nutrition as well as the green chlorophyl, because vitamin A is associated with this color in vegetables, butter, and egg yolk, it was discovered by S. M. Hauge and J. F. Trost of the Purdue University Agricultural Experiment Station.

Bacteria obtained from brewer's malt may now be pressed into the service of the chemist to eat away the cell walls of plant tissue and liberate the vegetable oil, according to a method developed by John Woods Beckman, Oakland industrial chemist.

A device for removing carbon monoxide from the exhaust gases of an automobile by means of a catalyst was demonstrated by the inventor, Dr. J. C. W. Frazer of Johns Hopkins University.

The richest source of helium yet discovered, a natural gas in southeastern Colorado containing 7 percent of helium, was reported by F. F. Hintze, of the University of Utah.

Crystals of rubber were obtained for the first time in the chemical laboratories of the U. S. Bureau of Standards.

Engineering

After a third attempt, Prof. Georges Claude was successful in obtaining power from the temperature difference in the ocean water at the surface and in the depths of the tropical seas off the Cuban coast.

The two longest steel arches in the world were closed; the Kill Van Kull bridge at New York with a 1675-foot span and the Sydney harbor bridge, Australia, with a 1650-foot span.

Final work was done on the new Welland canal, a mammoth structure built by Canada to pass sea-going lake grain vessels up and down the 326.5-foot difference in elevation between Lake Erie and Lake Ontario.

Plans were made and bonds authorized for the 35,000,000-dollar Golden Gate Bridge at San Francisco, the center suspension span of which will be 4200 feet, the longest in the world.

The Detroit-Windsor vehicular tunnel, connecting Canada and the United States beneath the Detroit river, was opened to traffic.

A severely streamlined railway car driven by a 400 horsepower airplane engine and propeller sped more than 100 miles per hour on a straight track in Germany.

The world's longest concrete arch bridge was built at Brest, France, with three spans, each of 612 feet.

The *Europa*, new German ocean liner, entered service and became speed queen of the North Atlantic by bettering the record of her sister ship, the *Bremen*.

Chicago's Merchandise Mart, said to be the largest building in the world, was completed.

The highest bridge in the world, carrying a highway 1260 feet above the Arkansas River, was completed over the Royal Gorge near Canon City, Colorado.

A radio telephone service was installed

ing possible the connection by radio phone of four continents—North America, South America, Europe, and Africa.

The first completely welded ocean-going cargo vessel was launched at Charleston, South Carolina.

A new field gun mount, enabling a 75-millimeter cannon to be trained at any point in a complete circle and elevated to any angle up to the vertical, was developed by the United States Army.

Progress in the design of windowless buildings lighted and ventilated entirely by artificial means was made and plans were announced for the construction of a 1,500,000-dollar windowless factory at Fitchburg, Massachusetts.

The United States Patent Office issued 49,599 patents and accepted 117,790 applications during the fiscal year ending in June.

The world's first metal base highway was laid as an experiment in Illinois.

Photographic films taken by the Andrée polar balloon expedition more than 30 years ago were found with the explorers' remains and developed and printed successfully in spite of deterioration by age and exposure to the elements.

Physics

The theory that the sun is lighted like a giant electric bulb by electricity under pressure of 10,000,000 volts flowing from inside the sun and heating its atmosphere to incandescence, was advanced by Dr. Ross Gunn, United States Naval Research Laboratory.

A new theory of the universe, assuming that it is non-static and consisting of matter dissipating through radiation, was propounded by Dr. Richard C. Tolman, of the California Institute of Technology.

The theory that cosmic rays are not rays at all but high-velocity particles was advanced by two German physicists, Dr. Walter Bothe of Berlin and Dr. Werner Kolhoerster of Potsdam, as a result of experiments they have conducted with a specially built adaptation of the electron counter, but researches of Dr. R. A. Millikan on the intensity of cosmic rays near the north magnetic pole provided evidence against the theory.

The theory that cosmic rays consist of high-velocity particles, like tiny bullets, was supported by experiments conducted by Dr. L. F. Curtis of the United States Bureau of Standards in which he used two electron counters.

A clock which will set itself in response to radio time signals was developed by H. C. Roters and H. L. Paulding of the Stevens Institute of Technology.

A new type of clock controlled electrically by a vibrating crystal, thus dispensing with a pendulum, was developed under the direction of Dr. W. A. Marrison, of the Bell Telephone Laboratories.

A moulded compound, including silicon carbide or Carborundum, which has the quality of preventing the flow of electricity at low voltages while allowing it to pass at high potentials, was developed at the laboratories of the General Electric Company.

A film phonograph capable of playing for two hours from a 400-foot reel of motion picture sound film was perfected by Dr. C. H. Hewlett, engineer of the General

Electric current direct from sunlight was made possible through the invention by Dr. B. Lange, of the Kaiser Wilhelm Institute for Silicate Investigation, of a new type of cell containing copper oxide between two layers of metallic copper.

Dr. Ernest O. Lawrence of the University of California, with his associate, Dr. N. E. Edlefsen, devised a method for increasing the speed and energy of the protons or hearts of hydrogen atoms so that it may be possible when the method is further perfected to use them as atomic projectiles for smashing the hearts of other atoms, transmuting them into other substances or releasing enormous quantities of atomic energy.

The final value for the most accurate measurement ever made of the constant of gravitation was announced after seven years work by Dr. Paul Heyl, physicist of the United States Bureau of Standards, to be the fraction 6.670 over 100,000,000.

Artificial gamma rays, which may take the place of radium in the treatment of cancer, are produced by a giant vacuum tube operating at 700,000 volts, at the California Institute of Technology.

An electric photo flash-lamp, a German invention, for taking flashlight photographs without noise or smoke was introduced in the United States, the light being made by aluminum foil ignited electrically in a bulb full of oxygen.

Recognitions and Awards

For his researches on light, particularly the discovery that monochromatic light when scattered by shining on certain transparent substances is partly changed to other colors, Sir Chandrasekhara Venkata Raman, professor of physics at the University of Calcutta, was awarded the Nobel Prize in physics.

The 1930 Nobel Prize in medicine was awarded to Dr. Karl Landsteiner of the Rockefeller Institute of Medical Research for the discovery that human blood is of four different types and that blood of one type does not always mix with blood of another type.

The Nobel Prize in chemistry was awarded to Prof. Hans Fischer of Munich for his achievement in the laboratory production of hemin, one of the components of hemoglobin, the red coloring matter of blood.

The Daniel Guggenheim gold medal for [illegible] achievement in aeronautics was ıwarded to Dr. Ludwig Prandtl, professor [illegible] the University of Göttingen, Germany, for "pioneer and creative work in the theory of aerodynamics."

The distinguished flying cross of the Navy was given to all members of the Alaskan Aerial Survey Expedition which mapped nearly 13,000 square miles of wild country during 1926.

The Collier trophy for the outstanding contribution to aviation was given to the National Advisory Committee for Aeronautics for its cowling for radial air-cooled engines.

Dr. George H. Whipple of the University of Rochester and Dr. George R. Minot of Harvard University Medical School shared the first 10,000-dollar *Popular Science* annual award given in recognition of their discovery of a successful treatment of pernicious anemia by the liver diet.

The Harmon Trophy for the outstanding achievement in aeronautics was awarded to Carl B. Eielson who piloted Sir George Hubert Wilkins across the Arctic.

The Perkin medal was awarded to the late Dr. Herbert H. Dow, president of the Dow Chemical Company, for his developments of improvements in the production of chlorine, bromine, magnes[illegible] r chemicals.

The James Douglas Medal of the American Institute of Mining and Metallurgical Engineers was awarded this year to John V. N. Dorr, president of the Dorr Company, for "his invention of apparatus and achievement in developing and improving hydrometallurgical practice."

The National Academy of Sciences' public welfare medal was given posthumously to Stephen T. Mather, organizer of the United States National Park Service.

The National Academy of Sciences' Daniel Giraud Elliot Gold Medal was awarded to Dr. Henry Fairfield [illegible]orn of the American Museum of Natu[illegible] History in recognition of his scientific [illegible]onograph describing the ancient titan[illegible]eres, a prehistoric creature somew[illegible]esembling the rhinoceros.

A gold medal and accompanying [illegible]ty of from 100 dollars to 500 dollars [illegible]e given government workers for scientific achievements was proposed in a bill before Congress.

The William H. Nichols Medal for 1930 was presented by the New York Section of the American Chemical Society to Samuel E. Sheppard of the Eastman Kodak Company for his "outstanding achievement in the chemistry of photography."

The Willard Gibbs medal was awarded to Dr. Irving Langmuir for "fundamental work on atomic hydrogen and on surface relations and also on electrical discharge phenomena; *also for his contributions* of great importance to nearly all branches of physical chemistry, including high vacuum technique, electronics, thermochemistry and catalysis, and lastly for his presentation of a theory of atomic structure."

The John Fritz Medal was awarded Rear Admiral Watson Taylor, U. S. N., retired, for his engineering achievements, the most notable of which is his utilization of the bow wave in ship propulsion.

The Edison Medal of the American Institute of Electrical Engineers was awarded to Prof. Charles F. Scott of Yale for his pioneering work in electric transmission.

The Franklin Medal, awarded by the Fra[illegible] o Sir William Bragg, director of the Royal Institution of Great Britain.

In recognition of his demonstration that protons act like waves, Prof. Arthur J. Dempster, of the University of Chicago, was awarded the 1000-dollar prize given annually by the American Association for the Advancement of Science.

The Hoover Medal was awarded for the first time, the first recipient being President Herbert Hoover.

The American Pharmaceutical Association gave its Ebert Prize for 1930 to Marvin R. Thompson of the University of Maryland for his work on the pharmacology of ergot.

Dr. R. R. Spencer of the United States Public Health Service was awarded the American Medical Association's gold medal for original work in preparation of a vaccine for Rocky Mountain spotted fever.

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COMMERCIAL PROPERTY NEWS

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e inquiries of our readers who may desire information relative to the various subjects reported in his department.
—The Editor.

Scarlet Fever Toxin Sustained

OF far reaching importance to public welfare and the health of children of this country is the invention of Drs. George F. Dick and Gladys H. Dick, of Evanston, Illinois, for scarlet fever toxin and antitoxin and process for producing the same, the patent on which was involved in a patent infringement suit brought by the patentees against Lederle Antitoxin Laboratories. Not only did the patentees make a meritorious invention, but the fruits of their discovery have been placed under the control of the Scarlet Fever Committee, Inc., of Chicago, a humanitarian institution, for the benefit of the public in general.

The patent describes the process for producing a toxin product and an antitoxin product, and claims covering the process and the toxin and antitoxin products were held to be valid and infringed.

The toxin product described in the claims of the patent as a sterile toxin specific, is injected into the arms of children to determine whether the children are susceptible to scarlet fever. The antitoxin specific is injected to render the children immune to the disease. The process consists in isolating hemolytic streptococci specific to scarlet fever, growing them in a suitable medium, and obtaining a sterile toxin product therefrom; thereafter injecting an animal with the sterile toxin product, and obtaining therefrom a serum containing antitoxin specific.

The court remarked in the decision in the foregoing case that placing the control of the patent in the Scarlet Fever Committee, Inc., so as to dedicate the invention to the benefit of the country, was the utmost manifestation the patentees could make of their desire to serve mankind and to live up to the ideals of their profession.

Patent Specification Ordered Revised

THE following statement by Commissioner of Patents Robertson concerns patent No. 1772175, issued to a Mr. Arbuckle.

"Applicant petitions from the Examiner's requirement to cancel the words 'and I desire, therefore, to claim the invention broadly,' appearing in the last sentence of the specification, which reads as follows:

"'Many other modifications may be resorted to without departing from the spirit of the invention, and I desire, therefore, to claim the invention broadly, limited only by the scope of the appended claims.'

"The Examiner in the office actions merely required the elimination of the phrase in question on the authority of Ex parte Champ, 114 O. G. 1827, and Ex parte Eldon, 83 O. G. 748. In his statement he points out that the broader claims have all been cancelled in response to rejection on the art, which he states is very close to the structure here disclosed. He further argues that since the interpretation of a patent is for the courts it is thought that the applicant can not give any directions as to how the court would exercise its discretion.

"The applicant argues that the language is unobjectionable, since he is simply intending to show that it was his intention to use the terms in the claims in as broad a sense as possible and that the language objected to is within the ruling in Ex parte Jansson, 120 O. G. 2126.

"In that case, in passing upon an objection to the statement that the applicant wishes to be understood that he does not desire to be limited to the exact details of construction shown, the Commissioner stated that, in case of any doubt as to the meaning of the terms, the intent of the applicant in so using them might become material.

"Obviously, however, a statement should not appear in a patent that applicant desires 'to claim the invention broadly as well as specifically,' if no broad claims have been allowed, and in view of the art applicant has been restricted to specific claims, since the patentee would not then be claiming the invention broadly.

"The particular statement of this application that applicant desires to claim 'the invention broadly, limited only by the scope of the appended claims,' would likewise seem to be objectionable, all the broad claims having been rejected and canceled, as indicating that applicant was claiming the invention more broadly than the claims themselves indicated. On the other hand, even if the language could be construed as a statement that it was desired that the terms of the claims be broadly construed, it would still be objectionable if only limited claims were allowed."

The petition is denied.

Request Review in Gas Device Case

A PETITION has been filed in the Supreme Court of the United States asking the court to review the case of Pratt et al. v. Weeks, Nos. 586 and 537, involving an unpatented device that allegedly enables a motor car to run 400 miles on one gallon of gasoline.

In addition to the gas-saving device, there is also involved an unpatented formula for a motor fuel, allegedly costing one cent per gallon to produce and claimed to be 60 percent more effective than commercial gasoline generally in use.

According to the petition, Nathaniel P. Pratt and George L. Pratt, the petitioners, entered into a contract with Charles J. Weeks, the inventor, for the organization of a corporation to exploit the inventions commercially. The contract provided for the payment of sums aggregat 1,000,000 dollars to Mr. Weeks with controlling interest in the corporation to rest with him. In return he was to disclose the inventions to be patented.

It is claimed that Messrs. Pratt paid in excess of 32,000 dollars under this agreement but that Mr. Weeks has declined to make any disclosures. Suit was instituted, the breach of the contract alleged, and damages were stated "in excess of 10,000,000 dollars." Judgment against Mr. Weeks was obtained in the trial court, but the Circuit Court of Appeals for the Fifth Circuit reversed its verdict.

Ornamental Design Not A Trademark

THE Converse Rubber Company, of Malden, Massachusetts, is not entitled to register, under the Act of 1905, as a trademark for rubber boots and shoes, a mark described as consisting of "a narrow external white band around the upper edge of the article of footwear," according to a ruling handed down by the Patent Office.

The ground of the decision is that the mark is nothing more than an ornamental design and would not function as a trademark.

In his decision, the First Assistant Commissioner, after noting the examiner's statement that it was common practice to place an ornamental band on boots and shoes but that he had cited no references to show that, called attention to certain design patents and stated that in view thereof it must be held that the conclusion of the examiner that the alleged mark was merely an ornamental border was correct.

He further stated that in view of the citation of new references a rehearing would be granted if request therefore was made within the limit of appeal.

"Worthless" Patent Yields $22,249,999

THE sale for more than 22,000,000 dollars of an oil "cracking" patent long regarded as worthless recently restored Mrs. Lolita Sheldon Armour to the commanding position in American finance once held by her husband, the late J. Ogden Armour.

The news that Mrs. Armour and a number of other persons suddenly had acquired unexpected millions became known when the Shell Union Oil Corporation and the

Standard Oil Company of California announced purchasing the Universal Oil Products Company for 22,249,999 dollars. Mrs. Armour owned 400 of the 1000 shares of Universal Products and will receive 8,216,558 dollars.

Included in the sale was the Dubbs "cracking" process for producing gasoline. P. C. Dubbs of Chicago, who invented the "cracking" process, which Armour backed for several years without success, will receive 3,582,045 dollars of the money derived from the sale, it was said.

Gem Advertising Curbed

IMITATIONS of diamonds are not to be labeled "Diamond," according to an or- [illegible] Federal Trade Commission to Frank W. Alter of Chicago, trading as Alter and Company, and Egyptian Gem Company.

Alter, who sells jewelry such as rings and stickpins to dealers for resale as well as directly to the public, is ordered specifically to cease and desist from using or conspiring with others to use the word "Diamond" and the words "stands the tests of fire and the acid bath," or words having substantially the same meaning in the advertising or labeling of stones or imitations which are not diamonds.

The Commission's order also forbids the representation of prices which are in excess of the regular prices as being the regular prices, and from representing postage or charges for postage, packing and shipping, to be more than they really are.

Instead of being set with diamonds or other precious stones, the goods sold by Alter contained pieces of glass, facet cut, or mined stones of small value, or imitations.

Alter caused to be printed coupons describing the spurious articles as diamond rings and diamond stickpins, and certificates guaranteeing this jewelry for certain periods or that a replacement would be made by the respondent.

The respondent then sold the rings and stickpins to traveling salesmen, whose addresses are unknown, among others, to one C. P. Mosert, knowing that they would offer the jewelry for sale to the public in connection with the c [illegible] cates, and the respondent, under the trade name Egyptian Gem Company, participated in the sale of the jewelry by the traveling salesmen under the terms of the certificates of guarantee.

Under the guarantee the respondent offered to replace the jewelry if it became tarnished; provided amounts varying from 25 to 35 cents were sent him for postage and packing, although the postage actually did not amount to more than two or three cents, and postage and packing together did not exceed five or six cents.

The regular and reasonable price of the rings and stickpins at retail was from 15 to 25 cents and the alleged replacements were really sales of rings at the regular and reasonable prices and were not bona fide replacements. In the coupons the rings and stickpins were represented to be of regular value or price of from three dollars to $6.50.

Tax Refunds on Patents

IN computing the amount of a refund on account of over-payments of income and profits taxes for 1913 to 1918 the market value of patents on March 1, 1913, and not their cost, should have been used in determining depreciation allowance, the District Court for the Eastern District of New York has held. This increased the depreciation allowance and hence the [illegible] refund, the opinion [illegible] plained.

In 1925 the Commissioner redetermined the company's 1919 tax by allowing depreciation for patents. This meant a decrease in invested capital for the years 1913-1918 and a corresponding increase in tax for those years, the court pointed out. When such a change is made in invested capital, however, the 1926 act provides that the income and profits taxes shall also be adjusted. In making that adjustment the market value of patents on March 1, 1913, should have been used, the opinion held, overruling the Government's contention that the adjustment should be made only for profits taxes, and that since the cost of

Courtesy United States Department of Agriculture

In order to meet market demands for officially stamped products, the Bureau of Agricultural Economics of the Department of Agriculture has devised the cheese branding machine shown above. Until recently, the Bureau states, there has been no practical method of legibly and permanently branding cheese after it has been paraffined. The machine shown has been put into use by the State Department of Wisconsin. It is described by the Bureau as follows: In this machine, metal letters for printing the brand into the paraffin are designed and placed to form 12 segments of a ring. Each segment is independently movable so that the face of the stamp can adapt itself to the contour of the cheese. The branding face is electrically heated and thermostatically controlled. The heated type face sinks into the paraffin, allowing the specially made, nondrying, oil-soluble ink to go down into the paraffin. When the brand face is removed, the melted paraffin flows into the depressions made by the letters, thus sealing the brand mark below the surface of the wax. There are a revolving brush and two ink rollers which clean and ink the stamp after each operation

Publication of Trademarks

IN order that trademarks and trade names may not become generic in character and thus lose their value to their owner, the words composing such marks should, when appearing in print, be capitalized or quoted. The editors of SCIENTIFIC AMERICAN exercise all possible care to see that this rule is adhered to, but even then a name will slip by once in awhile all in small letters. Two examples that have occurred in the past are Dry-Ice and Carborundum. We offer our apologies to the owners of these marks and hasten to make such restitution of prestige as this note

Geographical Mark Refused

IT was recently held by Assistant Commissioner Moore that the California Perfume Company, Inc., of New York, N. Y. and Kansas City, Mo., is not entitled to register the term "Avon" as a trademark for tooth brushes since this term is geographical.

In his decision, after stating that the word in question is the name of a village in New York, one in Ohio, and a town in Massachusetts, the Assistant Commissioner said:

"The law of trademarks (Act of February 20, 1905) specifically provides that a mark consisting of a mere geographical name or term shall not be registered.

"The reason for the law is that every manufacturer or dealer doing business in any town or village having the name Avon would have the right to appropriate such name to his goods."

BOOKS SELECTED BY THE EDITORS

FUNDAMENTALS OF GENERATORS AND MOTORS—
By F. E. Austin

BY a careful analysis of the component efficiencies the author develops these studies to bring out the commercial or financial efficiencies of generators and motors as a basis upon which to predicate a design which will meet the necessary qualifications for a particular service. Explicit diagrams connote the entire text of 108 pages which is as concise and abbreviated as clarity will allow. A mighty handy little work to have available for the understanding and design of fundamental electrical movers.—$2.65 postpaid.

GENERAL ELEMENTARY BOTANY—
By Elmer Campbell, Ph.D., Transylvania College

INTENDED to give a fundamental prospective of the plant world for introductory study, this work discusses practical problems fully, such as plant uses, weed values—of which the author has made a special study—nutrition, morphology, environment, and reproduction. Then are given plant development and taxonomy of seed-plants which comprise the major portion of the text. A clear and orderly development materially aiding reference and study yet pointing to further advancement should such be the desire of the reader.—$3.20 postpaid.

EXPERIMENTS IN ATOMIC SCIENCE FOR THE AMATEUR—*By James L. Clifford*

REAL practical instructions by means of which, with the expenditure of ten dollars for cheap impure radium salts and a few added pennies for simple apparatus, mostly homemade, the amateur may perform some of the most notable experiments in atomic physics—make radiographs as the Curies did, render alpha and beta rays visible (C. T. R. Wilson experiment), make and use electroscopes and ultraviolet arcs, measure the photo-electric effect and so on. Any boy between 15 and 115 years of age can have more fun and learn more in this manner than he could by spending an equal number of evenings at any other common indoor sport. —$1.65 postpaid.—*A. G. I.*

AMBER TO AMPERES—*By Ernest Greenwood*

A POPULAR story or scientific history of the development of electricity and its many applications from the earliest experiments to our own times. Though nicely produced on fine heavy paper and well bound, this book suffers from a most unusual fault. Samples of the text, read as a tour-de-force, indicate that the account deserves commendation, and it therefore is a pity that the type is so large and heavy it is difficult to read, thus creating a marked physical disability.—$4.20 postpaid.—*A. G. I.*

THE AMERICAN LEVIATHAN—
By Charles A. and William Beard

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THE DYNAMIC UNIVERSE—
By James Mackaye, Dartmouth College

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THE LURE AND LORE OF ARCHEOLOGY—
By Ralph V. Magoffin, Pres. Archeological League of America

THE author has compressed a vast amount of interest into the 107 pages of this little book, which covers as fully as possible in that short space an account of all the archeological research of the past few decades. A reader who, after finishing this account, did not discover himself broken out with the red rash of an archeological itch would be thick skinned indeed.—$1.15 postpaid.—*A. G. I.*

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JANES' ALL THE WORLD'S AIRCRAFT 1930
By C. G. Gray and Leonard Bridgman, Eds.

KNOWN as the official reference book for world aviation, this is a compendium divided into parts on civil, service, commercial divisions, aero-engines, and airships. Of large format, 8¼ x 13½, the profusion of illustrations are therefore large and clear, showing details which are often lost in reproduction. The most thorough and conclusive work of its kind published, the data being checked to the fall of 1930. An indispensable reference for everyone connected with the industry.—$13.00 postpaid.

A BOY SCOUT WITH BYRD—*By Paul Sipla*

NOTHING could be a finer endorsement of this book than Admiral Byrd's foreword which he wrote without reading the manuscript. You will enjoy the roguery of "Pete," the pep of "Belle"—for they were real companions and helpers even in their small canine way. Which is by way of saying that this is a he-boy's account of a marvellous adventure, told with simplicity and directness that gives a zest to the text throughout. The epic of Antarctic achievement will surely include this straight shooting sidelight.—$1.90 postpaid.

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FIVE YEARS IN TURKEY—

By Liman von Sanders, Gen'l, German Army

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THE ENGLISHMAN AND HIS BOOKS IN THE EARLY NINETEENTH CENTURY—*By Amy Cruse*

THE pre-Victorian period was an artificial and stilted one and anything which tends to shed light on the manners and customs is highly interesting. The present volume is full of information relating to what was read in the pre-Pickwick days when even a novel like *Camilla* was bootlegged. The word "novel" had a most unladylike and immodest sound in of the stricter section of the reading public so Madame D'Arblay therefore called it "sketches of character and morals put in action—not a romance." In the smug times of the nineties we find Mr. and Mrs. German Reed's entertainment with Corney Grain popular among those who would not go to the theater, so the English world has not changed very much. This book also deals with periodicals and their readers, lecturers and their audiences, drawing room books and other interesting subjects. The book is well illustrated but unfortunately lacks a certain something in the way of style which makes the book harder to read than it should be. —$3.70 postpaid.—*A. A. H.*

GREYHOUNDS OF THE SEA—*By Carl L. Cutler*

OF superb format with a plenitude of beautifully toned and colored illustrations, this is a complete study of the American Clipper ships; how and by whom their design was developed and what they accomplished. Parts of this history have previously appeared but this is the first full treatment. A foreword by our "salty" Secretary of the Navy gives the stamp of authoritativeness and accuracy. Seldom has a finer bit of production come to our desk than this which bears the Putnam imprint—congratulations! 592 pages, 118 illustrations, 8 x 10¾, with end page map compiled from Maury's Sailing Directions.—$15.00 postpaid.

AMERICAN WATERFOWL—

By John C. Phillips and F. C. Lincoln

WHAT a pleasure it is to browse through such an excellent format as this book discloses. Gems of headpieces in pencil by A. L. Ripley, distinctive wash drawings by Allen Brooks, both in aquatone, depict the more common varieties of fowl. The type, the paper, and the binding make a fine volume for the most esthetic library. Conservation of course is the keynote—the present situation and the outlook for the future. Each chapter has been viséd by an expert to obtain authority and accuracy. A "must" for every library that includes sports.—$4.70 postpaid.

EDUCATION OF A PRINCESS—

By Marie, Grand Duchess of Russia

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TUBERCULOSIS—*By F. H. Livingston*

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BRIDE OF THE RAIN GOD—*By T. A. Willard*

FROM the Spanish translation of an old Mayan history, this story has been drawn to set forth the ancient legend of the Princess of Chichen-Itza. It depicts the actual life, habits, and customs of the builders of the now ruined Mayan cities of Yucatan, in the form of speech denoted by the original history. Interesting illustrations depict what scientific research has developed as to the form and appearance of the marvellous structures these ancient peoples erected. One seems to get from this story more of the real atmosphere of those times than is obtained from the more or less matter-of-fact records of recent exploration. Interesting and instructive.—$2.65 postpaid.

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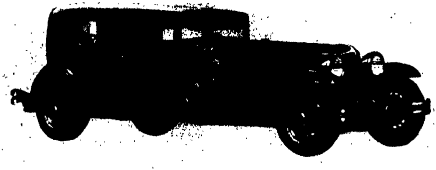

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SCIENTIFIC AMERICAN

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EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

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THIS MONTH'S COVER

Some of the specially built ships for transporting locomotives fully assembled across the ocean are so small that one locomotive, hoisted aboard by the ship's crane, causes the ship to list considerably. The *Beldis* of Oslo, Norway, shown in our cover painting by Howard V. Brown, has a dead-weight tonnage of 3400 tons. She is staunchly built, however, and her listing does not interfere with the loading of a number of such locomotives as the 88-ton Baldwin, which is also shown.

LOCAL TELEPHONE SERVICE ONCE COST

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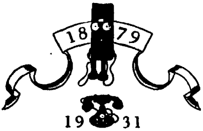


In 1879, the New York telephone directory was a card listing 252 names. There were no telephone numbers, nor any need for them. When you telephoned, you gave the operator the name of the person you wanted. Service was slow, inadequate and limited principally to people of wealth. The cost of a single telephone was as high as $240 a year.

Today, you can talk to any one of hundreds of thousands of telephone users for a fraction of what it then cost for connection with less than three hundred. Every new installation increases the scope and value of the telephones in your home or office.

Twenty-four hours of every day, the telephone stands ready to serve you in the ordinary affairs of life and in emergencies. In the dead of night, it will summon a physician to the bedside of a sick child. Men transact a great part of their business over it. Women use it constantly to save steps and time in social and household duties. In an increasing number of ways, it helps to make this a united, more active, more efficient nation.

Simply by lifting the receiver you become part of a nation-wide communication system that uses 80,000,000 miles of wire, and represents an investment of more than $4,000,000,000. Yet the cost of local service is only a few cents a day.

Subscribers who look back over the month and consider what the telephone has meant to them in convenience, security and achievement are quick to appreciate its indispensable value and reasonable price.

Frequently you hear it said—"The telephone gives you a lot for your money."

★ *AMERICAN TELEPHONE AND TELEGRAPH COMPANY* ★

ACROSS THE EDITOR'S DESK

THE mail that streams continuously through an editorial office is always a source of diversified interest. Queries to be answered, comments on articles that have been published, caustic remarks from those who feel that their pet subjects have been slighted, descriptions of new inventions, manuscripts for consideration, letters from cranks on subjects ranging from unemployment to the Einstein theory—all these and more come in the day's work and all are necessary to the process of getting out a magazine that will please the greatest number of people.

●

With this great variety of mail clamoring for attention, it is pleasant to sit back once in a while and contemplate a letter such as one that reached us a few days ago. It was written by Mrs. Lillian Randall of Pasadena, California, and told of an old friend of hers, Hawley R. Drum, who has been a constant reader of the SCIENTIFIC AMERICAN for 72 years, having started at the age of seven. A self-educated man, Mr. Drum was instrumental in building the first railroad bridge across the Missouri River and, Mrs. Randall wrote, his self-acquired knowledge of surveying was so accurate that experts could find no fault with it. Through all his travels around the country, Mr. Drum has always managed to obtain the SCIENTIFIC AMERICAN as each issue appeared and now at 80 years of age he is still as ardent a reader as ever. Our hat is off to Mr. Drum for what we believe is a record in devotion to one periodical; our thanks to Mrs. Randall.

●

As we prepare the copy for this page, there is before us the original painting for the cover of our May issue. Although it concerns aviation, the phenomenon which is the center of attraction in the painting was mentioned in the Bible.

●

"Which Races Are Best?" is the title of an article scheduled for publication in our May issue which, at first glance, seems to be an excellent opening for the start of a heated controversy. But we read further and find that science cannot admit as yet that there are racial differences in intelligence. "Inferiority" and "intelligence" are relative terms and to measure either one of them, it is necessary that those under examination be given the benefit of every consideration. Even if a result could be reached, how long would it hold true? Humanity is in such a constant state of flux that all of the findings of science may be upset within a comparatively short time. We predict that this article will be widely read and will furnish material for endless discussions.

●

"Its bells can be heard eight miles distant" is said of the carillon that has just been installed and dedicated in the Riverside Church in New York City. The beautiful tones of its 72 bells will make of this church a Mecca for music lovers throughout the world. Behind this appeal to the ear is the illuminating story of the foundry where the bells, from the 10-pounder tuned to "C" to the 20-ton "bourdon," are cast with an artistic skill that is reflected in the perfect tones and overtones of the finished carillon. An article on this subject is scheduled for May.

●

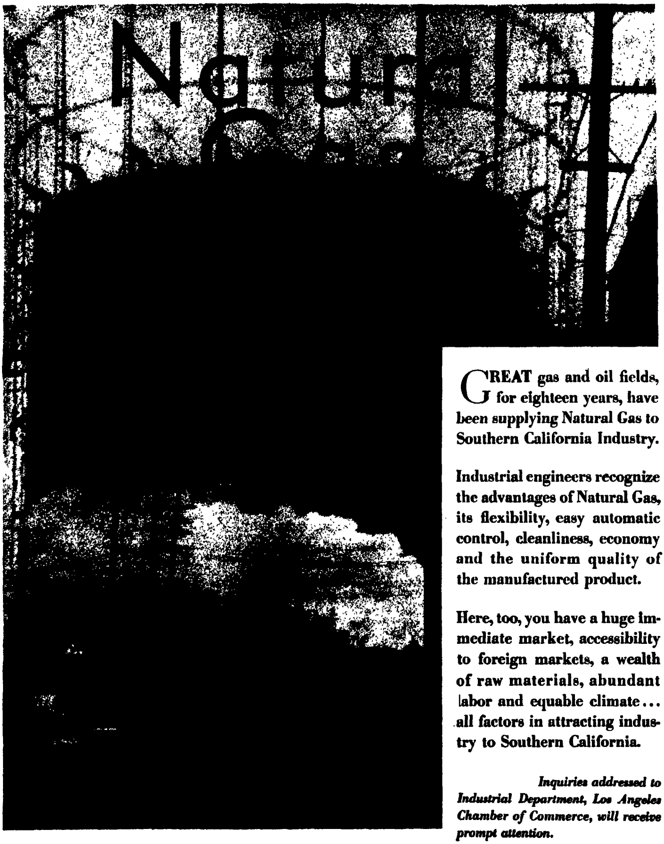
Dr. Heyl of the Bureau of Standards has written for us another article on pure science. This time his subject is "How Big is a Quantum?" Those who were "stumped" by the statement that a quantum of star light is as big as a barrel, made in Dr. Heyl's article entitled "What is a Quantum?" which appeared in our December, 1930 issue, will find in the coming dissertation more information that will undoubtedly add to their knowledge. But even Dr. Heyl states that much still remains to be learned about the quantum. Therein lies one reason for the fascination of science: we are always learning, always replacing old theories with new. Every goal reached is found to be, not the end, but a stepping stone to further discoveries.

●

We have just received from England a report on further work that has been done in investigating the great Siberian meteorite fall of 1908. As the fall occurred in a remote part of the world, it received little comment at the time. Now, however, it has been discovered that a micro-barographic record of the air wave resulting from the fall was made in England, but filed away because no significance was attached to it at the time. Our correspondent has obtained, from the Russian leader of expeditions that have explored the site of the fall, some unusual photographs and sketches that will be reproduced in connection with his article.

●

Our May issue will also present articles on such diversified subjects as the new naval dirigible now under construction, a typewriter in which all of the mechanical work is done by electricity, the work of the research chemist in industry, the tallest man-made structure in the world, archeology, astronomy, and others.



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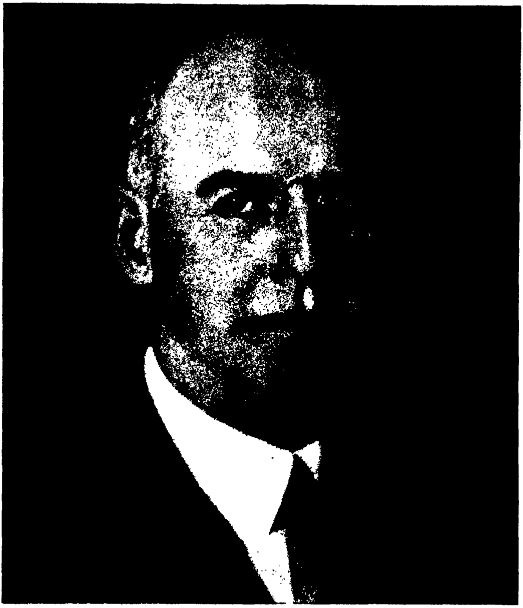


ALVAN MACAULEY

OCCASIONALLY there is a young man who just can't seem to be kept within the confines of one job. He masters many problems and incessantly reaches outside his regular job for more. Such a one was Alvan Macauley when, as a young man of only 23 years, he was patent attorney for the National Cash Register Company.

Mr. Macauley was born in Wheeling, West [illegible] 1872; and was educated in the public schools of Washington, D. C., and at Lehigh and George Washington Universities. He was only 20 years of age when he took his degree of LL.B. from George Washington. For five years he practiced law in Washington, specializing in patent law. He did such a good job of one patent case for the National Cash Register Company that John H. Patterson hired him as the company's patent attorney. He could have become lost in the mazes of patents surrounding cash registers—as intricate as the machine itself—but he didn't. Within three years he had grown out of the patent job entirely and for a time had complete charge of the engineering and development work of the company. In 1901 Mr. Macauley became General Manager of the Burroughs Adding Machine Company, where he faced trying e[illegible]utive problems from the first day.

Directors of the Packard Motor Car Company had been watching the progress of the General Manager of the Burroughs company and in 1910 Mr. Macauley accepted the position of General Manager of the Packard Company. In 1916 he was elected President and General Manager, which position he holds at present as well as that of Director.

THE RED FUSEE IS A SIGNAL TO STOP

AT night, red-burning fusees, sometimes called flares, afford a splendid means of warning to railroad men. The fusee is the counterpart of the torpedo in daylight. They are not, however, used together. The fusee's crimson light is effective on dark and foggy days and in tunnels. Flares are an essential part of the brakeman's equipment, along with his lantern and supply of torpedoes. To protect his train, if necessary, the brakeman lights his fusee and sticks it in the ground or throws it off. The engineer on a train following sees the signal, extinguishes the fusee, and proceeds with caution, having been fully warned of the train ahead

THE EYES AND EARS OF THE RAILROAD

By FRANCIS X. MILHOLLAND

Assistant to the Senior Vice-President, Baltimore and Ohio Railroad

WITH a quarter of a million miles of railroad track in this country—enough to circle the globe ten times—thousands and thousands of passenger and freight trains follow, pass and re-pass each other every day. Daily they carry tens of thousands of people and millions of marketable tons from place to place. Is it not amazing, when one stops to think of it, that this enormous activity is carried on with apparent ease, that these trains are all kept on rigid schedules and reach a high average of on-time performance and safety? What is the source of this efficiency?

The answer lies chiefly in the perfection of railway signaling. By night and day, the twinkling lights the traveler sees along the route and shining in the yards, are so many faithful guides to guard the path of each train.

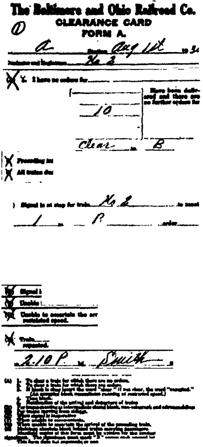
The modern complex art of railway signaling, in which the swift, sure power of electricity is taking a more and more prominent rôle, had its beginnings in the necessity for avoiding confusion and collisions in freight and passenger traffic and in the desirability of giving certain trains precedence over others. One of the first major developments, applicable on a large scale, was the manual block system, the chief principles of which are still in use. The lines of the railroad are divided into sections, or blocks, each section protected by signals, and the operators, located in strategically placed stations, control the necessary signals by hand through the manipulation of levers. Such signals are usually of the semaphore type and are operated in three positions: Horizontal—means "STOP"; Diagonal—conveys the message, "CAUTION"; Vertical—the way is "CLEAR."

The manual block system does not permit a passenger train to enter a block that is occupied, and no other train is allowed to enter a block occupied by a passenger train. A freight train, however, where the rule provides, may follow another freight train, but the diagonal position or the "proceed with caution" signal is then displayed.

A torpedo is clamped to the rail and is detonated by the locomotive

The blocking operations are handled independently between adjacent stations (see manual block system diagram). Station B gives information to stations A and C; stations B and D are notified by station C. When a train approaches station A, it is not permitted to pass toward station B until communication is made between stations A and B, when the word is passed along that the block is clear of trains coming from the opposite direction.

UNDER the manual block system, the issuance of many train orders, accompanied by "Form A" clearance cards, is necessary. The uses of these are too numerous and involved to recount here, but one example may be stated by way of illustration. In this case a meeting point is to be fixed by train order. Train No. 1 and train No. 2, let us say, are approaching from opposite directions on a single stretch of track. Where are they to meet? The answer is given to the engineers and conductors through train orders at a telegraph station advising them that they are to meet at intermediate non-telegraph station B. When train No. 1 arrives at station A and No. 2 arrives at station C, they are again reminded by a train order that they are to meet at the middle station B. The signals at stations A and C, however, are at



The Baltimore and Ohio Railroad Co.
CLEARANCE CARD
FORM A.
①
A Station Aug 1st 193-
Conductor and Engineman No 2
X 1. I have no orders for
10
Have been delivered and there are no further orders for
Clear to B
X Preceding tra
X All trains due
Signal is at stop for train No 2 to meet
1 at R order
Signal l
Unable t
Unable to ascertain the arr restricted speed.
X Train reported.
2.10 P. M. Smith
(A) 1. To clear a train for which there are no orders.
2. To clear a train for which there are orders.
3. If block is clear insert the word "clear." If not clear, the word "occupied." (An occupied block, necessitates running at restricted speed.)

A clearance card is necessary for use with the manual block system

"stop," in accordance with railroad rules for train order stations, and trains cannot pass these signals without being authorized by a "Form A" clearance card. The engineers and conductors are therefore supplied with clearance cards, at stations A and C respectively, stating that certain orders have been delivered to them, that there are no further orders, and that they may now proceed, the block being clear to station B, their meeting point.

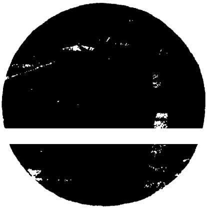
While the manual block system provides protection, it is supplemented and improved by the next step in the evolution of train operation by signals—the automatic block signaling system, which has the added advantage of detecting, electrically, such things as a broken rail, a car in a siding but too near the main track, a switch not properly closed, and other accidental hazards that formerly could not be discovered ahead of time. This ingenious invention is superimposed on the manual system, as shown in the automatic block signaling system diagram. Closer train movements are allowed because trains *following* one another are spaced *automatically*; that is, through contact of the locomotive wheels with certain electrical connections in the track. Trains moving in the *opposite* direction, however, are protected by the manual block system, although the automatic system acts as a check on the former, giving double assurance of safety.

For the operation of trains on a single track, there has been invented another system, styled the controlled manual block (see diagram). When trains are scheduled to meet on a single stretch of track, one of them must, of course, go on a siding to let the other pass. The engineer knows whether or not he is to go on the siding by the rules governing the superiority of trains, some of which are allowed precedence over others, or he may receive train orders to tell him what to do. But under the controlled system he is governed entirely by signal indication and train superiority is cancelled. This is made possible because the towerman can himself control passing siding switches instead of depending upon someone else to throw them as under the ordinary manual block system. These passing siding switches, even though in some instances a mile from the central control or block office, are electrically operated by motor-driven apparatus controlled from the tower.

All illustrations courtesy Baltimore and Ohio Railroad

The manually operated lantern target signal switch is a familiar sight t

The controlled manual block system diagram shows the siding switch thrown and the signal properly set for the westbound train to enter the siding, while the eastbound train may advance as far as the "stop" signal east of the block office. Here it is held until the opposing train has entered the siding and the switch has been thrown back to allow traffic to proceed again over the main single track.



A tower-operated mechanical lantern dwarf signal is easily seen by engineer

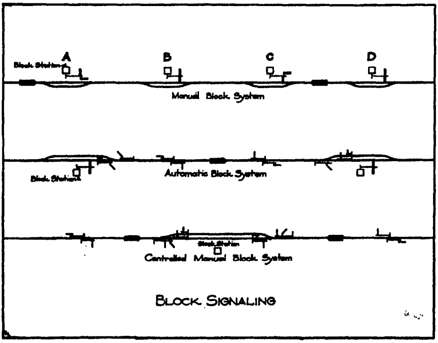
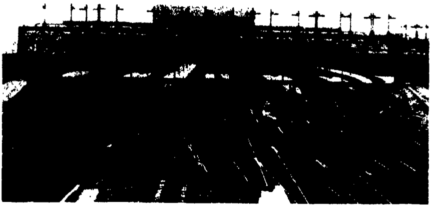
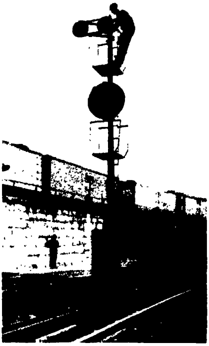


Diagram of the manual, automatic, and controlled manual block signals

Outside the passing siding limits, that is, the single track section extending from the double track at one station to the double track at the next station, dual protection is provided for opposing directions. First, electrical connections in the control circuits are so arranged that the operator can not manipulate the controlling machine levers to permit reversal of traffic until all track circuits throughout the single track section are unoccupied, all hand operated switches closed, and an unlock given by the towerman at the next station. This "interlocking" of signals through the use of electrical instruments is one of the most important safety features in modern signaling. Secondly, when the route is set in one direction, signals for trains coming from the other direction are caused to indicate "stop." Protection is therefore provided both by means of traffic locking and through the automatic signal.


Signal bridge, Washington terminal, where incoming trains receive final signals and outgoing engines signaled to proceed. Interlocking station is in foreground

An electric dwarf signal with eight lights can give many instructions


The signal maintainer is cleaning the lenses of a color position signal

The engineer protected by interlocking systems gets his orders to leave the Washington terminal

THE telegraphers in the towers handle directly the interlocking machines controlling the switches and signals for single or lap passing sidings, and work under the supervision of the dispatcher. The term "lap" is used where two sidings, one located on one side of the main track and one on the other side, overlap each other so as to permit two trains to pass in opposing directions without stopping. Automatically, the approach of trains is announced to the respective towermen, who inform the dispatcher. This operation does not require more than 15 or 20 seconds. Then the dispatcher directs whether [illegible] ll be permitted to advance onto the main track or take a siding; if the latter, the switch is thrown, the signal set and the train is not brought to a stop until the last car of it is clear of the main track. The operator closes the main switch and other trains are signaled to pass. But if the dispatcher gives the word for the train to stay on the main track, the towerman, co-operating with the next station, sets the route, clears the signal or signals, and the train continues on its way at normal rate of speed.

In large passenger terminals, a great many signals are concentrated in a comparatively small area, and the result is a highly involved pattern of switches, tracks, and signals which appear hopelessly interwoven and baffling to one unacquainted with the mechanical intricacy of the terminal.

Consider Union Station, at Washington, D. C., for example. The Washington terminal property covers a ground area of over 18 acres, includes 60 miles of track, and an interlocking network of signals and switches requiring the use of over a million feet of electric wiring. The track arrangement entering from the North consists of three double track lines converging at the New York Avenue interlocking plant and diverging into ten parallel tracks which run through to the point where they again diverge to 32 station tracks at the K Street interlocking plant.

Trains on all these tracks are operated by signal indication and without train orders, or superiority rights. Each track is operated in both directions. This is made possible through the use of interlocking machines designed to safeguard every movement by apparatus interconnected so as to compel proper sequence of manipulation controlling the many switches and signals. Each lever is electrically governed to insure correspondence between itself and the apparatus it controls.

A MAJORITY of the scores of trains entering the terminal daily are turned on "Y" tracks and backed into any one of the 32 tracks in the station. During this operation, four large interlocking towers are passed; an 80-lever all-electric plant at 12th Street; an 88-lever all-electric plant at Rhode Island Avenue; a 71-lever electro-pneumatic plant at New York Avenue; and a 191-lever electro-pneumatic plant at K Street.

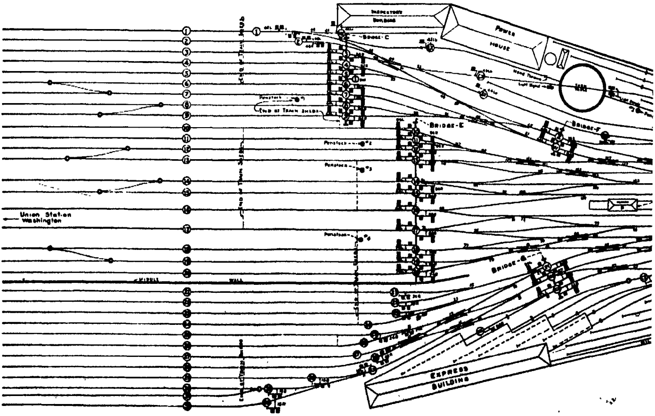
Tower K is the largest control plant in the terminal. To aid the train operators and the levermen in their important work, a large illuminated track chart, supported on one wall, shows by the extinguishing of lights the exact location of all trains approaching or those within the interlocking limits. Above the heads of the train directors are numerous miniature signals; tiny semaphores, indicating the close proximity of trains approaching the plant; numbered circles, giving immediate information as to the starting of trains from the station; and four large circular dials registering the passage of a train from K tower to the other towers and the destination of the train. Through this elaborate system, no matter what track a train is on, it can be led onto any other track.

The hand or flag is moved the same as lantern. Here the signal is "Stop"

Picture yourself, for example, on one of the trains nearing the terminal. The tower train directors are informed of the approach of the train and its routing is planned. Assuming that it will be received on track 34 (see extreme upper right of K-interlocking diagram) but is to occupy station track 32 (extreme lower left), the director calls route US at Bridge J to shed-track 32 and gives the lever combinations 171-169-167-165-163-97-95-93-91-21-14-170L. Taking the opposite direction, if a train is reported ready to leave track 1 (extreme upper left in diagram) to move to track 43 (extreme lower right) the director orders the route set and calls combinations 49-133-135-137-139-185-187-189. In both cases, the governing signal or signals will properly indicate the desired route and all switches in advance of the train will be electrically locked until the last car has passed.

ONE of the most interesting developments in the mechanics of signaling is the color-position-light block signal, first employed on the Baltimore and Ohio Railroad six years ago and now in use on over 400 miles of road.

These signal lights, which can be seen clearly in the daytime through the improvement in electric lighting, instruct engineers and trainmen unmistakably by color and the position of lights on the circular dial what they are to do or not do. Vertical green indicates



At the Washington terminal the trains enter the yard at the right and are pas

two or more blocks ahead of the train are clear. Diagonal yellow, from right to left, tells the engineer that the immediate block is clear but the second block ahead is not clear and that he must "proceed, prepared to stop at next signal." Diagonal lunar white (white with a bluish tinge) from left to right, gives the word, "permissive," or "proceed with caution." Horizontal red says, "stop." The first color-position-light signal was the joint invention of the late signal engineer of the Baltimore and Ohio Railroad, Frank P. Patenall, and his first assistant, George H. Dryden, who is now signal engineer.

The increasing use of the color-position-light signal is attributed to several important advantages it has over the semaphore. These signals are controlled by continuous track circuits, that is, electrical connections with the tracks are so arranged that the passing of a locomotive over a signal zone automatically and instantly sets the lights.

Supplementing the signals for general operation are the hand, flag, and lamp signals. Consider, as an example, the picturesque sign language of the lantern or lamp. When the trainman swings his lantern across the track, it means "stop." Held horizontally at arm's length when the train is moving, the lantern says to the engineer, "reduce speed"; or in the same position, when the train is standing, sends the message, "ready to leave." Raised and lowered vertically, the word is flashed to "proceed." Swung vertically in a circle at half-arm's length across the track when the train is standing, the signal is to "back." But when the train is running and the lantern is swung in a circle at arm's length across the track, the code of the railroad tells the engineer that "the train has parted." If the trainman swings his lantern horizontally above his head when the train is standing, the engineer is told to "apply the air brakes." When the lantern is held at arm's length above the head while the train is standing, the message to the engineer means "release the air brakes." The flag or the hand, used in these ways, conveys the same messages as the lantern. Another signal recognized by all engineers is an informal but very familiar and urgent one, and it is not necessary to be a railroad man to give it. When the engineer sees someone waving any object violently on or near the track, it means to "stop."

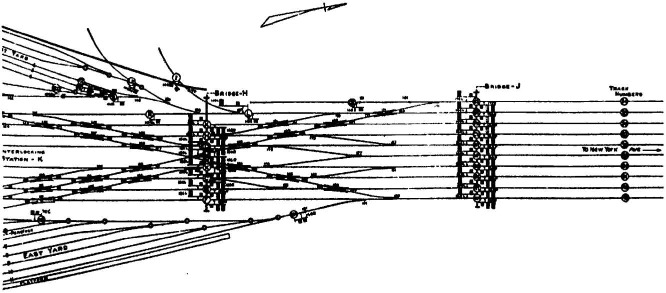
Trainman signaling "Stop" with flag. Night signal on opposite page

THESE signs are for the eye, but there is another means of communication in railroad signaldom which appeals to a different sense. There has been developed an ingenious system of sound signals, using the locomotive's vociferous whistle. To the uninitiated, these blasts are unintelligible. Apparently, they are sounded at random, but in reality every series of whistles has a meaning, and to these shrill messages every railroad man within earshot listens subconsciously and understands them.

For the benefit of those who have listened to the language of the locomotive and felt curious to understand what it says, these are the messages that come from its steel throat:

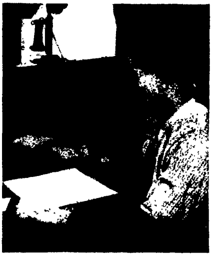
One short: apply brakes. Stop.

Two long: release brakes. Proceed.



o the train shed at left by signals on bridges all controlled by interlocking

***Above:* Train passing a tower at Baltimore. Nearby signals and switches are controlled from tower. *Right:* A tower operator on duty**



One long, three shorts: flagman protect rear of train.
Three shorts, one long: flagman protect front of train.
Four long: flagman may return from West or South, as case may be.
Four long, two shorts: flagman may return from West or South, under certain conditions.
Five long: flagman may return from East or North, as case may be.
Five long, two shorts: flagman may return from East or North, under certain conditions.
Three long: when running, train parted; to be repeated until answered by the trainman's signal.
Two shorts: answer to any signal not otherwise provided for.
Three shorts: when train is standing, back.
Four shorts: call for signals.
One long, two shorts: to call the attention of yard engines, extra trains, or trains of the same class or inferior right to signals displayed for a following section. Also to be given when passing track or bridge gangs.
Two long, two shorts: approaching public crossings at grade.
One long, continuous whistle: approaching stations, junctions, and railroad crossings at grade.
One short, one long: inspect train line for leak.
Succession of short sounds: alarm for persons or live stock on the track.
Two shorts, one long: answer to flagman's stop signal.

THE ringing of the locomotive's bell, which tolls a warning in the yards and on the right-of-way, might also be called part of the signal system.

The torpedo plays a loud and efficient part in sound signaling. The explosion of two torpedoes is a sharp warning to reduce speed and look out for a train ahead or obstruction. The explosion of one torpedo will indicate the same as two, although the use of two is required. move with caution after torpedo explosions until a signal is received that the way is clear. At night, fusees are sometimes used as signals.

When the conductor wishes to get in touch with the engineer to notify him to stop, to start, to reduce or increase speed, as the case may be, he pulls the bell-cord and passengers hear the familiar "psst-psst" of the signal.

Still another group of signals to be assimilated by railroad men is that which takes in the numerous flag and light displays on the rear-end of a train or the front of a locomotive, or the rear of the tender or caboose. Each color, light, or flag has a different meaning.

All of these carefully worked-out signaling systems and methods have been gradually built up and perfected along with the development of the railroad. The layman might find the various mysteries of the art explained in the railroad's Book of Rules, but when signals are flashing and sounding the railroad man cannot stop to thumb the little book to look up the rules. They must become second nature to him. He has to know the signals by heart, for they are "the eyes and ears of the railroad."

***Left:* Levermen in the great tower "K" at the Washington terminal are operating the machine levers of which there are 191. The train directors are in the background. *Right:* Electro-pneumatic signal tower, track diagram, and levers**

OUR POINT OF VIEW

An Awakening Due

STRANGE—and inexplicable—how the American people wax enthusiastic over some subject or theory for a while and then promptly forget all about it! Having been most emphatic that we be allowed naval parity with Great Britain and our demands having been granted by the London Conference, we are now apparently willing to drop the subject although we are still far from measuring up to it.

The Navy League showed in a recent analysis that "the Administration proposes to begin building less than 16 percent of our naval deficiency in the fiscal year and, therefore, leaves more than 84 percent of it to be undertaken in the fiscal years 1933 and 1934—or later." The Administration program makes provision for: aircraft [illegible] although allowed by the treaty 55,000 tons; small-gun cruisers, 17,500 tons although allowed 73,000 [illegible]s; destroyers, 16,000 tons although allowed 150,000 t[illegible] 4,400 tons although allowed 26,000 tons. No provision whatever is made for large-gun cruisers, of which class we are allowed 30,000 tons.

In 1922 at Washington we surrendered an existing superiority in capital ships in order to set an example. From then until 1930 we built but little while other signatory nations built heavily in categories n[illegible]ted by the Washington Treaty, [illegible]n by the follo[illegible]

	U.S.	Gr.Br.	Jap.	Fr.	
Submarines					
Destroyers	0	22	47	48	37
Cruisers (1922 to 1929 only)	8	15	15	8	6

Passage of the 15-cruiser bill by the United States in 1929 gave us at the London Conference in 1930 the support of an authorized fleet of these vessels; we had an ace in hand although on the whole we led from weakness, and our efforts at the Conference almost came to naught. At the rate we have started authorizing the tonnage allowable under the London Treaty, it rather looks as though in 1936, when that treaty expires, we shall be confronted with the problem of leading from a more deplorable weakness than ever before. Already there is a hint that Great Britain may exercise her Treaty right to build more than the tonnage allowable, because of Italy's avowed purpose to build ton for ton with France. If Great Britain does build to keep ahead of this particular race between non-signatory nations, our inconsiderable efforts will be hopelessly eclipsed. Naval limitation by example has been proved absolutely unworkable and that ideal is out of the question; to achieve any results at all, we simply must have not one but several aces in our hand.

In Washington there are a number of men who are supposed to be representatives of the people, but who play politics, squabble among themselves over all manner of trivial things, and ignore major issues. It is about time the people realized that these men are their elected servants in government and as such should see that the nation gets what we have bargained for: naval parity or what-not.

Arthur G. Halfpenny

IN recording the death on February 12 of Mr. Arthur G. Halfpenny, we pay just tribute to a man whose work as Circulation Manager of Scientific American for more than a quarter of a century touched the lives of all our readers. His [illegible] following pneumonia from which he was apparently recovering. For a year or more he had suffered intermittently from heart trouble, grippe, and gen[illegible] indomitable spirit few realized how ill he was.

Born in County Mayo, Ireland, Mr. Halfpenny early joined the merchant marine and after years on the sea settled in New Zealand where he became a ship's reporter and later held a master's license. Following [illegible] in the English army, he settled i[illegible] where he married a New York girl. He learned the magazine circulation business with *Harper's* and 27 years ago became Circulation Manager of Scientific American. He numbered among his friends many men of high rank in the publishing business; and so sound were his principles and judgment that they constantly sought his opinion on matters affecting magazine distribution. During his years with us, his duties held paramount importance in his life as is attested by the sound circulation he built up.

Lopsided Progress

MAN'S primary physical needs are three—food, shelter and clothing. Since the beginning of the Age of Science he has made essentially no gains in the art of clothing himself, modern clothes being about as inefficient as clothes were in the Dark Ages. In the art of sheltering himself from the elements he has made some good gains, though it seems probable that [illegible] the houses of our own time with genuine ho[illegible] is in the category of foods that we have made our greatest advances. The largest slice of our food progress is the discovery, not very old, of ways to preserve foodstuffs in seasons and years of plenty, in order to provide a uniform supply in seasons and years of dearth; [illegible]e foodstuffs e[illegible]cally from one place to another in order that supply may balance demand. We have practically abolished and forgotten the seasonal aspects of food avail[illegible]nd it is no longer extravagant to have foods o[illegible]ccept th[illegible]s if they had always existed, but it doubtless would prove illuminating if a committee of moderns could drop back into earlier times and send us a report on the food situation. It is a safe guess that the committee would not like the board.

In the science of housing we shall undoubtedly make heavy gains, while in the matter of clothing, unless some miracle alters human nature the indications are that we shall stay in the Dark Ages. But in the art of nourishing our bodies we are moving rapidly along the broad shining road from here to somewhere.

A good example of this rapid advance is described in a short article in the present number, entitled "New Light on Old Foods." Other important developments are in the laboratory stage, and, as soon as they appear to be commercially practicable, they will be described in these pages.

International Affairs

The Soviet Economic Menace

WE have been regaled at length with the danger to our economic position from the Five Year Program of the Soviet government. People, who should be better informed,

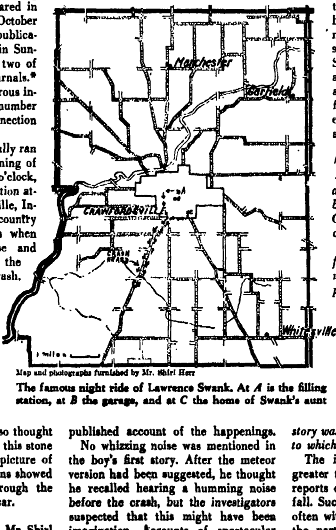
(*Please turn to page* 282)

DID A METEORITE STRIKE THE CRAWFORDSVILLE FORD?

By **CHARLES CLAYTON WYLIE**
President of Midwest Meteor Association,
Associate Professor in Astronomy, University of Iowa

MANY, if not most, readers of this publication doubtless have seen the recent story of a meteor going through the hood and radiator of a Ford car in Indiana. The account, which has been given nation-wide publicity through many periodicals, was usually accompanied by a picture of the damaged Ford with the owner, Lawrence Swank, standing beside it pointing to the hole. This story appeared in newspaper despatches in October and later in certain weekly publications. It has since appeared in Sunday features and in at least two of the more popular scientific journals.* The writer has received numerous inquiries, perhaps a greater number because he was quoted in connection with some accounts.

As published, the story usually ran about as follows: On the evening of October 10, 1930 at about ten o'clock, Lawrence Swank, a filling station attendent living in Crawfordsville, Indiana, was driving in the country about four miles from town when he heard a whizzing noise and saw a fiery object strike the hood of his car with a crash. He drove the car home, and found embedded in the generator, a piece of stone which was pronounced meteoric by professors at Wabash College. Examination of the pavement showed a dent made by the meteorite, and a farmer living nearby found a strange stone which was also thought to be meteoric. The picture of this stone sometimes accompanied the picture of the Ford, and some illustrations showed a streak of fire passing through the hood and radiator of the car.



Map and photographs furnished by Mr. Shirl Herr

The famous night ride of Lawrence Swank. At *A* is the filling station, at *B* the garage, and at *C* the home of Swank's aunt

AT the request of the writer, Mr. Shirl Herr of Crawfordsville, and Professor G. E. Carscallen of Wabash College, each made a very thorough and careful investigation of this story in an attempt to get at the facts of the case as nearly as possible. They agree that no one questions the veracity of the Swank boy. His story has been checked as carefully as possible, and no reason has been found for doubting that he is telling the truth as nearly as he can recall. There are, however, several inaccuracies in the published account of the happenings.

No whizzing noise was mentioned in the boy's first story. After the meteor version had been suggested, he thought he recalled hearing a humming noise before the crash, but the investigators suspected that this might have been imagination. Accounts of spectacular meteors often include the hearing of a swishing or whistling noise at the time the meteor is seen, but such reports are heavily discounted by the fact that the person who hears the noise usually is in a motor car or in some place where other noises interfere; while the trained observer sitting on a porch where everything is quiet in the same neighborhood hears nothing. Further, real sounds from the meteor, due to the relatively low velocity of sound as compared with light, must be heard after the disappearance, just as thunder is heard after the disappearance of lightning.

No streak of fire was seen by the boy at the time of the crash and no meteor which can be associated with the damage to the Ford has been reported seen by anyone. We may add that, even if the damage had been caused by a meteoric stone, no streak of fire would have been seen passing through the car. Stone meteors disappear at an average height of about 15 miles, and any stones which survive fall from that elevation to the earth as dark bodies invisible at night.

THE piece of stone found under the generator of the car at Crawfordsville was examined by Professor Howell, of Wabash College, and pronounced a piece of Carborundum.

The stone brought in by the farmer and pictured as meteoric was examined and pronounced a piece of cinder.

The striations, or scratches, in the hole in the pavement do not run in the right direction to have been made by a projectile passing through the car.

At the time of the incident the meteor idea did not occur to the boy; this story was started by a man at the garage to which the car was taken.

The inaccuracies are, however, no greater than those commonly found in reports of a real or supposed meteoric fall. Such stories usually are added to, often without intentional dishonesty on the part of anyone. In one case the writer received his first notification of a supposed Iowa fall in the form of a clipping which included the report that he had pronounced meteoric a piece of metal found, of which he had not even heard. In the case of a recent report on a supposedly meteoric fall near Champaign, Illinois, a story received by the writer included a report that professors at the University of Illinois had

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***Popular Science Monthly*, January 1931; *Science and Invention*, February 1931. Feature articles appeared in the *Chicago American*, December 31, 1930 and *New York Journal*, January 3, 1931. An account was published in *The Pathfinder* in November 1930. An account by Mr. Jack Cajnar was submitted to the *Scientific American* in mid-November, rejected on scientific grounds
Digest, November 29

pronounced meteoric a stone found on that occasion, of which they too had not even heard. The inaccuracies are, therefore, only what is found in average reports on such an incident. News writers can not take time to investigate all the details of a story, but the scientific man should. (Incidentally, making such an investigation means that his report must appear long after the story of the news writer has been sent out).

THE correct version of the Crawfordsville incident, from the investigations of Mr. Herr and Professor Carscallen, is about as follows: On the evening in question Lawrence Swank was driving his car at a distance of about three miles from Crawfordsville and in a direction away from town (see sketch map), when he heard what he thought to be the report of a gun. He assumed someone was shooting at him and, being rather badly frightened, he turned around at a point, perhaps a half mile beyond, and drove back to town as fast as he could. He was staying with an aunt and it was at her home that the damage to the car was discovered. The aunt and her daughter saw the holes immediately after his return. The car stood on the street over night and the next morning was driven to the garage from which it had been purchased. *Here was made the first suggestion that the damage was due to a "shooting star".*

The car was then put on display at the filling station where young Swank was working, and the piece of stone (Carborundum, an artificial product) was discovered under the generator. As there was no other obvious explanation of the incident nearly everyone seems to have accepted the meteor theory; excepting that the Wabash College professors have continued to be skeptical. Some time that forenoon Mr. Herr and others drove out with the Swank boy to the place where he had heard the crash, and a fresh dent found in the pavement *was attributed* to the missile thought to have passed through the car.

In deciding whether or not the damage was caused by a meteor several facts must be considered. First, a meteor large enough for its stones to survive rapid passage through the upper atmosphere and drop to the surface of the earth should have been very brilliant and conspicuous in spite of the moonlight, not merely in Indiana but in the adjoining states. We know the weather was clear on that night, as several fairly bright meteors were seen, one by residents of Crawfordsville, Indiana, and others in Wisconsin, Iowa, and Minnesota. However, there has not been a report on any meteor which can be associated with the damage to the Ford. Professor Carscallen states that the one seen in Crawfordsville can not be so associated, and those seen by residents of the other states were not in Indiana. This fact —that such a meteor was not reported— must be considered strong evidence that there was no such meteor, as many letters generally are received concerning spectacular objects. For instance, a brilliant meteor which fell on the afternoon of Monday, December 8, 1930, not far from Vandalia, Illinois has been reported to us from Iowa, Illinois, Indiana, Kentucky, Tennessee, Arkansas, and Missouri. More than 200 letters have been received concerning it.

Again, a meteor which drops stones to the surface of the earth is almost always, if not invariably, accompanied by detonations or explosions usually louder than the most severe thunder. The first blast of a detonating meteor is followed by a roar which crashes back into the distance, and such a noise would not be mistaken for the simple report of a gun. No such blast was heard at Crawfordsville, the only explosion heard being that which young Swank took for the report of a gun. This also must be considered strong evidence against the meteoric theory.

Lawrence Swank pointing to the small hole afterward found in the pavement

The upper one of the two holes in the car. "The suggestion favored by most persons is that the incident was put across as a clever practical joke"—on Swank

STILL further observation and calculation agree that as meteoric stones approach the earth the direction of fall approaches the vertical, and the velocity approaches a velocity such that the pull of gravity on the stone is balanced by the resistance of the air. Even the large stone of the Paragould fall (SCIENTIFIC AMERICAN, February, 1931) which weighed about 800 pounds, was falling in a practically vertical direction when it struck, although in the upper atmosphere the meteor had been traveling at a very low angle. Where small and large stones are recovered from the same meteor, the evidence is that the smaller stones have dropped even more perpendicularly than the large. A stone small enough to go through the holes in the hood and radiator of the Swank boy's car should certainly have been falling in an almost vertical direction, and should not have had sufficient velocity to do nearly that damage. The only possible way in which a meteoric stone of that size might have struck at an angle of approximately 45° and with such a velocity would appear to be in case it had fallen attached to a quite large stone until it was very near the surface of the earth, then broken off at that point and, because of its irregular shape at the time of breaking and because of the relatively high velocity at which the large stone was falling, had fallen away at the angle of about 45° and with the velocity at which the big stone was falling. However, such an explanation appears to be quite impossible in connection with the Crawfordsville incident, for a stone nearly as large as the Paragould meteor would have been required, and the detonations accompanying the fall at Paragould, Arkansas were so loud that they awakened sleepers in three states.

Lawrence Swank pointing to the upper hole. Note other hole in radiator. A meteoric stone of this size would normally not penetrate the hood. Despite the high velocity of meteors when seen aloft in flight, small ones quickly slow down on encountering the atmospheric cushion. When the acceleration of gravity is balanced by air resistance they reach a practically uniform "terminal velocity" which is not high. The probable joke played on Swank rebounded to half of the nation, for it can be demonstrated that millions of persons were given the meteor explanation through the combined circulation of the numerous periodicals which accorded publicity to the original account despite its unscientific earmarks

FINALLY, a simple computation shows that the chance of a car being struck by a meteorite is exceedingly small. Meteoric falls are now being recovered in the United States at the rate of about one every 16 months, using an average for the past 30 years. We know, however, that only a small fraction of those which fall is now being recovered. From those which fall close enough to farmers working out of doors to be seen it is possible, assuming uniform distribution, to make an estimate of the total number which fall in the United States per year, and a computation just made by the writer indicates that we are recovering not more than 1 percent of the total. On this assumption a meteorite should strike a car somewhere in the United States not oftener than once in 500 years and, in the long run, an authentic report of any sort of damage to a car by a meteorite should appear only once in that number of years.

A peculiar feature of the widespread story is that after hearing the report Swank drove several miles at as high a speed as the car would travel without knowing that anything had struck it. Garage mechanics consider this unusual. With a hole of that size in the radiator one would assume that so much water would immediately be drained out as to heat the engine. This causes us to wonder whether the holes actually were made at that time, or perhaps earlier or later. If made earlier the broken tubes must have been plugged with wax or fixed in some way to prevent the water draining out too rapidly.

Aside from the meteoric theory, the suggestions most commonly made are that the damage was caused by a slug from a shotgun; that a wrench or bolt fell from an airplane; or that the holes were made as a practical joke. If, as Mr. Herr and Professor Carscallen feel, the Swank boy is telling the truth, the slug from the shotgun, at least at the time of the report, is ruled out. No one was in the car with him; and from the direction of the holes a man seated on a tree or telephone pole beside the road could not have caused the damage. A shot from an airplane seems wildly improbable. A wrench or bolt dropped from a high-speed airplane might, in the opinion of the writer, have made the holes, but this appears very unlikely.

The suggestion favored by most persons is that the incident was put across as a clever practical joke. A letter received in November included the comment, "it looks funny, perhaps phoney." The Carborundum obviously was put there as a joke. The holes through hood and radiator, in a line to indicate that the missile had passed close to the head of the driver, are just what one would expect as a joke, although the angle almost rules out stones from a meteor or objects dropped from an airplane. The writer considers a deliberate attempt to put across the meteor story more unlikely than a simple, but premeditated, attempt to frighten young Swank by making him believe some one was shooting at him. Perhaps two friends who knew he was planning a drive in the country after work, rammed the holes, and partially plugged the broken tubes in the radiator. When, as they had hoped, he drove away without noticing the damage, he was followed and a gun was fired.

THE meteoric theory was advanced, and has been accepted by many, merely because no other suggestion appears probable; but this very natural but illogical form of reasoning by exclusion nearly always leads to erroneous conclusions. Workers in the field of meteors and meteorites regularly receive stones which the senders are sure must have fallen from heaven, as "no other explanation is considered possible." But in 99 out of 100 cases these specimens are quickly identified as ordinary terrestrial rock. The meteoric explanation of the Crawfordsville incident must therefore stand or fall on its own merit and the mere improbability of other suggested explanations should have practically no weight in making the decision.

To summarize: A report of damage of any sort to a car by a meteorite should appear not oftener than once in 500 years. Next, only large and spectacular meteors drop stones to the earth. Such meteors are well reported (more than 200 letters on one of December 8, 1930). The fact that, with all the publicity given this incident, we have no reports from persons who saw or heard such a meteor is strong evidence that there was no such meteor. The writer knows of no instance where it has been established that a meteoric stone has fallen at an angle very far from the vertical. A meteoric stone the size of an egg would normally not penetrate the hood of a car. The angle of striking, and the damage done, are therefore, like other points, against the meteoric explanation.

NEW LIGHT ON OLD FOODS

EIGHT and one half years ago it was discovered that ultra-violet rays would convert something in foods into vitamin D, the bone-forming, sunshine-health vitamin. A way has now been found to do the same thing controllably. This is a big advance. Until very recently the artificial methods of equipping foods and pharmaceuticals with vitamin D could not be called controllable. They consisted, as they still do, in irradiating the substances with ultra-violet rays, but not enough attention was given to the wavelength of these rays and some of the results therefore proved to be oddly contradictory. For example, the rays actually destroyed the largest portion of the vitamin they had created. A subsequent event in food science concerns the solution of this puzzle and sends us to the city of Cincinnati.

At about the time the original discovery was made that ultra-violet radiation creates vitamin D, a young student of electrical engineering at the University of Cincinnati, whose name was George Sperti, became interested in the electrical aspects of the production of ultra-violet rays, and from that his interest was diverted to the effects of these rays on the living substance and to other problems in biophysics and biochemistry. What followed not only "reads like a romance" but is one.

THE originative student Sperti soon attracted the attention of Herman Schneider, president of the University, who was a scientifically trained man, and the upshot was that these two agreed there was immediate need of a biophysical laboratory. As there was no such laboratory at the University of Cincinnati and no easier way to acquire one, Sperti took off his coat and cleared the junk and cobwebs out of a small space in an attic and installed one. This did not take long because there was little available apparatus to install. Sperti's motive, and that of President Schneider too, was to test certain ideas concerning the application of some of the laws of physics to living matter—specifically the action of light, which includes in its full scope not only ultra-violet rays but X rays and other forms of radiation, on the living substance.

Sperti did most of the labor, while his superior backed him up with ideas and encouragement. Money was scarce but this situation—the meagerness of material resources and the tiny garret laboratory into which two could scarcely fit themselves at the same time—need arouse no sympathy. Some of the best work in science has been done under similar stress. If you would kill a research worker's initiative, give him every luxury money can buy.

The world soon made the proverbial "beaten path" to Sperti's door because it found he was making a "better mousetrap" than anyone else. He had already found something decidedly worth looking into. Funds for further research began to move in his direction. Today Sperti is Director of the "Basic Science Research Laboratory," no longer under the rafters, and at 30 is a professor. A quarter of a million dollars has been paid, it is said, for patents on his discovery of the basic principle of the "selective irradiation" of foods.

Left: **Professor George Sperti who "started something," and, at the right, President Herman Schneider who stood behind him with help and encouragement as he worked**

What had chiefly interested Sperti was the problem of untangling a snarl in ultra-violet wavelengths in connection with organic matter. Different wavelengths seemed to have different effects. The whole range of the ultra-violet could not be lumped together as had been done previously—it must be unscrambled. Many other research workers had approached the same problems but mostly by cut-and-try methods—empirically. Sperti approached it from another direction. He, with President Schneider's help—always generously given—sat down and attempted to think of possible causes lying behind this confusion. They invoked something seldom or never brought to bear on organic matter, the quantum theory.

According to that theory, today virtually a principle in physics, radiant-energy is liberated in separate pieces or "bullets," instead of in a continuous stream. These bullets of light are larger as the wavelength becomes shorter. It requires a bullet of a certain size to produce a given physical effect—for example, to convert a substance into vitamin D—and a larger bullet (shorter wavelength) ought, it seemed theoretically, to undo the same effect. This looked like an explanation of the strange making and unmaking effect of ultra-violet rays on vitamin D. The longer waves were making the vitamin, the shorter ones were unmaking it. The answer which Sperti worked out was to isolate and use the ultra-violet waves of a certain length, 2960 Angström units.

Experiments fully confirmed this form of reasoning, and this is the "selective irradiation" principle for which Sperti received the small fortune—which, by the way, he at once turned over to the University for further basic research in science. If men of science could cultivate the necessary amount of financial dickering instinct to sell some of their basic finds for hard cash and do what Sperti did, it seems possible that larger returns for basic scientific research might be acquired by themselves than are acquired now through the attempt to convince rich men that pottering over laboratory apparatus is likely to bring to light vast new sources of riches if only these men will finance the pottering.

THE University of Cincinnati and the General Foods Corporation, which acquired the patents, organized a joint holding company, and a new laboratory is to be erected at the University from funds accruing to it from the discovery just described and from other discoveries made in the Basic Research Laboratory.

One of these other discoveries is likely to prove as significant as the first. Foods can also be sterilized with light. Milk, for example, can be sterilized. This fact, as such, is not new. For years it has been possible to sterilize milk with ultra-violet rays but it always has had this disadvantage: it spoiled the taste of the milk. It was found by the Cincinnati workers that this effect was due to the inclusion of the wrong wavelengths with the correct ones when the milk was irradiated. But now selective irradiation sterilizes milk without making it unpalatable, and adds vitamin D to it into the bargain. Foods which are not transparent to ultra-violet rays—which means virtually all foods, for the rays do not penetrate most solids—are sterilized with X rays of long wavelength—soft X rays or "Grenz" rays.

It is altogether probable that these advances in food science will begin to affect what you eat within a comparatively short time.

Southern Pacific's 5603-foot double-track bridge across Suisun Bay in California. Costing a total of 12,000,000 dollars, it was completed in the fast time of eighteen months

UNIQUE SOLUTIONS OF BRIDGE

By C. R. HARDING
Assistant to the President, Southern Pacific Company

THREE methods of bridge construction that differ considerably from the practices usually followed were adopted by the contractors who sank the foundation piers and erected the super-structure for Southern Pacific's 5603-foot double-track bridge across Suisun Bay in California.

These unusual features were: 1. Creation of artificial islands of sand on which concrete piers were built in sections above water and gradually sunk to bedrock; 2. Use of a deep-sea diver, as low as 140 feet under water, to examine all pier foundations; 3. Temporary use of one of the permanent deck spans as falsework during construction of the other permanent through truss spans.

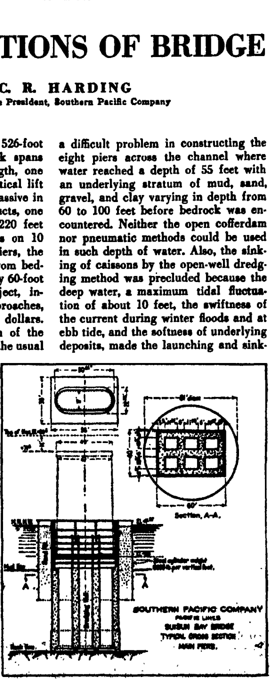
The structure is the longest and heaviest railroad bridge west of the Mississippi and is not exceeded in its load-carrying capacity by any bridge in the country. Its piers are designed to withstand a given intensity of earthquake shock and the span can support the almost incomprehensible weight of a train on each track extending the full length of the bridge, consisting of locomotives and cars twice the maximum weight of a present-day train load.

THIS Martinez-Benicia bridge, as it has been named, is 35 miles from San Francisco, spanning a body of water in the far reaches of San Francisco Bay. Opened for traffic on October 15, 1930 after 18 months of construction, it caused the retirement of the two car-transfer steamers, famous as the largest ferry boats in the world, which had for years been a fascinating phase of transcontinental travel in carrying whole trains across Carquinez Straits between Benicia and Port Costa.

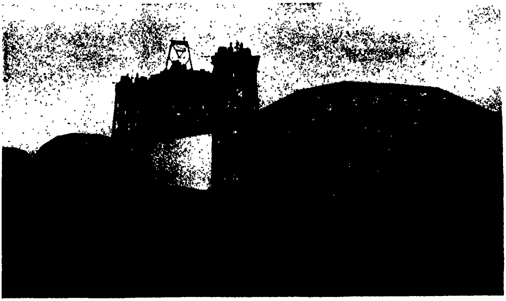
The bridge consists of seven 526-foot through truss spans, two deck spans 264 feet and 504 feet in length, one 328-foot, 1580-ton, through vertical lift span (the heaviest and most massive in the world), and two end viaducts, one 560 feet long and the other 220 feet long. The super-structure rests on 10 main piers and 22 pedestal piers, the deepest of which is 207 feet from bedrock to bridge seat, with a 40 by 60-foot base. The entire bridge project, including six miles of track approaches, cost approximately 12,000,000 dollars.

Construction of that portion of the sub-structure on land followed the usual method of excavating to suitable rock foundation. The viaduct pedestals in water, the maximum submergence not exceeding 13 feet, were constructed by driving cofferdams of Wakefield sheet piling. Two of the deep-water piers were constructed within open cofferdams of interlocking steel piles 65 feet in length, which were driven inside a timber falsework. One of these piers is probably the deepest ever constructed using a cofferdam consisting of a single row of steel sheet piling, the distance from high water to rock foundation being 58 feet.

The bridge engineers faced a difficult problem in constructing the eight piers across the channel where water reached a depth of 55 feet with an underlying stratum of mud, sand, gravel, and clay varying in depth from 60 to 100 feet before bedrock was encountered. Neither the open cofferdam nor pneumatic methods could be used in such depth of water. Also, the sinking of caissons by the open-well dredging method was precluded because the deep water, a maximum tidal fluctuation of about 10 feet, the swiftness of the current during winter floods and at ebb tide, and the softness of underlying deposits, made the launching and sink-



Drawings showing method of construction of the piers



The heaviest lift span in the world, weighing 1580 tons, in the new bridge. The bridge proper has a clearance of 70 feet, but the great lift span can be opened to a clearance of 135 feet in only 85 seconds

CONSTRUCTION PROBLEMS

ing of a timber crib impracticable.

The first step in the unique method adopted involved the driving of 90 110-foot Douglas fir piles, on which was constructed an octagonal wooden platform. Eight equally spaced, 45-foot steel hoisting towers, with winches, were erected on the platform. Under each tower was a steel girder, tied down by steel rods bolted to the piling. Provision was also made on the platform for a stiff-leg derrick with 40-foot mast and 84-foot boom framed with its cross-section diagonal placed vertical.

Upon the working platform was then assembled a cylindrical steel shell 81 feet in diameter, of ½-inch plates, reinforced by 6 by 3 inch angles, and laid out in eight segments. The shell was assembled in 10-foot sections upon cribbing, three sections being bolted together as a unit. When the 30-foot unit was completed it was suspended from the eight steel towers, being raised by blocks and tackles to hand winches, while the cribbing was removed. The shell was then lowered by the winches operating simultaneously at the eight towers, the downward movement being carefully watched and regulated so as to keep the shell level and perpendicular at all times.

When the first unit was lowered, the inside ends of the girders were bolted to the shell and the suspension cables were removed. Additional 30-foot units of the shell were assembled, then bolted to the previous unit, and the lowering operation repeated. This procedure was continued until the shell had sunk into the mud and sand a sufficient distance to be self-supporting. Jetting and dredging assisted in sinking the shell to greater depth. Removable trusses 60 by 40 feet long braced the inside of the shell horizontally to prevent distortion or collapse while being lowered. When the shell was settled these trusses were unbolted by a diver and removed.

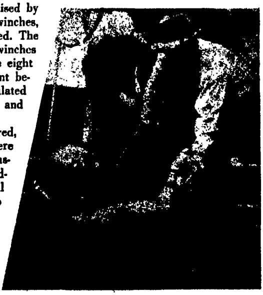
The shell was then filled to mean low water level with sand dredged from a point one-half mile upstream barged to the pier site and unloaded by clamshells. Approximately 9500 cubic yards of sand were required. The top of the sand was leveled with clamshell buckets and by jetting, after which the cylinder was unwatered to a depth of about 12 feet below high water.

Upon this artificial island was then laid out the steel cutting edge of the caisson that was to be sunk to rock. Walls six feet thick divided the caisson into six dredging wells each 11 feet 8 inches by 10 feet 6 inches. Removable steel forms were used for the outside of the caisson above the cutting edge and for the dredging wells, they being loosened and raised by derrick for each successive pouring of concrete.

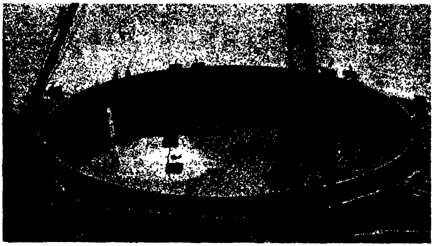
After the reinforcing steel had been placed, the first 15-foot lift of concrete was poured. Successive lifts were 10 feet in height. All of this work was done above water and enabled the working crews to pour concrete of desired quality and strength; it also permitted them accurately to center and orient the concrete mass as it settled toward bedrock.

WHEN 35 feet of the caisson had been poured, clamshell excavators operated from floating derrick barges began the removal of sand from the six dredging wells, permitting the caisson to sink gradually under its own weight. Extreme care was taken in the dredging to keep the caisson level, check measurements being made about every two hours during the sinking operations.

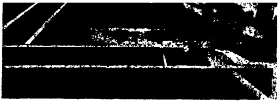
At the time of starting the concrete caisson, four test borings were made on the longitudinal and transverse axes of the shell by means of which the exact elevation of the bedrock was determined at four points conforming to the four sides of the caisson. This information determined the proper height of the caisson prior to sinking and the elevation at which to commence the construction of a timber cofferdam that extended from elevation -20 to well above high water. The cofferdam was later used in pouring the distribution block and in erecting the pier shaft from a depth 30 feet below high water. Reduction from the large section of the caisson to the



The deep-sea diver who was used to inspect all pier foundations under water



Above: Steel shell, 81 feet in diameter, sunk into mud and filled with sand to form an island on which to construct the caissons. *At right:* Construction of a caisson, showing the end of one of the cutting edges



smaller section of the pier shaft effected a saving in the amount of concrete used and created a temporary bridge seat or shelf that was later used to support the steel bents of a falsework bridge span.

When the caisson was landed at or near bedrock, and after the greater part of the material immediately above bedrock had been removed by hydraulic jetting and clamshell excavation, a deep-sea diver was sent down one of the dredging wells to explore the bottom. He telephoned the conditions existing within and under the caisson, which enabled the contractors to direct jetting operations accurately so that the foundation area was put in a clean condition. The diver gave accurate information as to the penetration of the cutting edge of the caisson into the foundation rock and brought to the surface samples of rock encountered, which furnished helpful information. The inspections assured that the bridge piers were actually resting on bedrock, that the full bearing had been secured, and that an interlocked connection was established between the steel cutting edge and foundation rock. It is believed this is the first time that a deep-sea diver has been used at such great depth of water in open-caisson work.

THE foundation was then sealed by depositing tremie concrete through the water in the dredging well by means of a 10-inch pipe to a depth of about 30 feet. When the concrete had set, the remainder of the dredging well was unwatered. A thin covering of mud and laitance was then removed from the surface of the concrete and pouring was resumed in the dry. The six wells were filled in succession. The next step was to pour the distributing block—a huge mass of reinforced concrete 10 feet thick, 50 feet long and 33 feet wide—after which the pier was completed by the pouring of the pier shaft to bridge-seat elevation in 10-foot lifts, using wooden forms held in position by being bolted to the concrete section immediately below the one being poured.

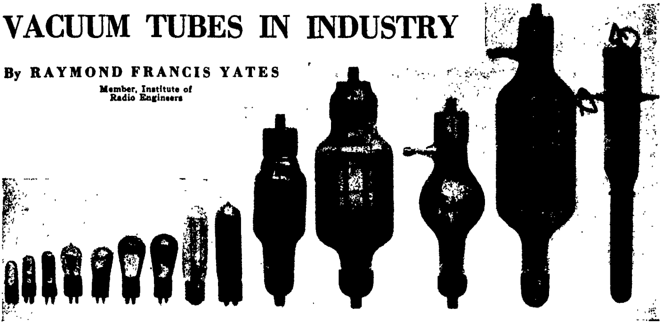
Another unique feature of construction was involved in erecting the steel spans in the super-structure. Various methods were considered, but it was not deemed possible successfully and economically to use timber piling owing to the depth of water, softness of mud, water current, and height of piers above water. It was finally decided to use one of the steel deck spans as falsework for the erection of the other spans. This span finally took its place as the most northerly span in the bridge. It was erected on piling sunk in the shallow water at the south end of the bridge, and on completion was floated on two steel barges to a position between the first two deep-water piers. The span was brought to rest on shoulders of each pier which had been provided for in construction at elevation -20. When in position, the falsework span had its top chords at an elevation permitting the laying of erecting tracks and the placing of the blocking upon which the permanent span was erected. The false work span was floated between successive piers as the work progressed.

THE contractors and engineers of the railroad were highly pleased with the result of the unusual construction methods. The particular advantages were that concrete was placed in the dry; no timber was left in the pier; reinforcing steel could be properly set; and the work was carefully inspected at all times, insuring the highest grade of reinforced concrete in the piers. Labor, material, and time were saved in using the deck span as falsework, instead of attempting to use piling.

Total weight of steel in the superstructure of the bridge is 44,000,000 pounds, including 25,000,000 pounds of silicon steel, 5,500,000 pounds of heat-treated eyebars, and the remainder of carbon steel. The piers required 105,000 cubic yards of concrete and 1500 tons of reinforcing steel. An average clearance of 70 feet is provided. The 1580-ton lift span can be raised to a clearance of 135 feet in 85 seconds.

Deck span being floated into position between piers. It served as falsework for construction of the permanent through truss spans between each pair of piers

VACUUM TUBES IN INDUSTRY



By **RAYMOND FRANCIS YATES**

Member, Institute of
Radio Engineers

DURING the past five years the [illegible] of research work done by radio physicists has [illegible] sulted in the successful application of vacuum tubes to highly diversified industries; the manufacture [illegible] steel products, cigars, chemicals, paper, [illegible] canned goods are but a few of the industrial arts that have been greatly aided by the flow of electron streams made sensitive to light, to changes in capacity, and to sound. Although the science of vacuum tubes is still young, it has asserted itself and we now find that they have been taught to do no less than 200 chores that lie outside the quite ordinary job of radio transmission and reception.

Electronic control involves the use of three different types of tubes: the ordinary amplifying vacuum tube such as that employed in radio receivers, the photo-electric cell, and the grid-glow tube. The first mentioned is always used to amplify the effects of the latter two, although it is also used independently in many instances in detecting small effects and measuring small distances.

In a way, these devices operate to supplant the human sense organs; the detecting and amplifying tube is capable of "hearing," the photo-electric cell is capable of "seeing," and the grid-glow tube is capable of "feeling." In each case, the devices are far more sensitive and more accurate than the human senses which they are being called upon to replace. We shall be more greatly impressed by this fact when we learn that an electron tube has been found capable of measuring a current of only 63 electrons a second. This infinitesimal whiff of energy amounts to [illegible] is [illegible] enough to detect this sm[illegible] of energy should it be [illegible] even though electronic devices are capable of detecting and measuring these extremely small effects, they operate with surprising stability and reliability. Little wonder that so many things have been found for them to do. Still greater will be the wonder, if our physicists and engineers do not find many other things for them to do within the course of the next few years.

Courtesy Westinghouse Electric and Manufacturing Company

The photo-electric cell in this unit "spots" unwrapped yeast cakes, whereupon they are removed

In the operation of a wire mill, the problem of keeping the product at a uniform diameter has been a rather trying one due to the failure of dra[illegible] dies, and other technical considerat[illegible] [illegible] at the pre[illegible] automatic caliper which keeps a co[illegible] stant check on the diameter of the ou[illegible] [illegible] nodificatio[illegible] of the ultra-micrometer circuit i[illegible] by Dowling. This particular circuit has been made sensitive to small changes in capacity and the measuring unit takes the form of two condenser plates, their movement being translated into electrical effects that may be made visible on a milli-ammeter in the output circuit. Some idea of the amazing sensitivity of the ultra-micrometer circuit may be had when it is stated that the bend in a table top caused by the weight of a 25-cent piece may be measured with it.

PRECISELY the same method of measurement has been successfully applied to paper making in keeping a constant check on the thickness of the product. In this particular instance, the paper issuing from the mill passes between two condenser plates and very small variations in thickness are easily detected.

When glass bottles are blown by machine, molecular strains often develop and these strains cause weak glass very susceptible to small changes in temperature. The shock brought about by hot water from a faucet will shatter such bottles. Consequently, it has been one of the problems of the glass industry to prevent such strains from forming. Only the most expert eye can see anything but the most obvious imperfection. During the past year, a way has been found to apply the photo-electric cell to this problem and now such flaws may be found automatically. (See page 120, February, 1931, SCIENTIFIC AMERICAN. *Ed.*) Ten years hence the glass blowing industry will set down the figures and determine its indebtedness to a few billion electrons being sucked across a vacuous space to the positively charged grid. Photo-electric cell circuits have been developed to a point of efficiency where they permit this tube to see things that are far beyond the limits of human sight. It sees more, and sees it more accurately.

In chemistry, the vacuum tubes (both the thermionic tube and the photo-electric cell) are rapidly assuming the importance of the beaker, the balance, and the distillation apparatus. Such a highly specialized job as the measurement of viscosity (the degree of "thickness" or fluidity) is already being turned over to the vacuum tube. A click heard in the telephone receivers connected to an oscillating circuit permits the chemist to determine viscosity with a new degree of accuracy. But that is only one job that the electron tube is learning to do in the chemical laboratory.

AN astronomer uses a series of vacuum-tube amplifiers in connection with a thermo couple to measure the heat of a star a thousand light years distant. The chemist may measure the temperature of a reaction by practically the same method. And he may do many other things with the thermionic tube and the photo-cell. If he is an organic chemist he may exercise a new degree of control over such processes as nitrations, brominations, and chlorinations. If he is an inorganic chemist he will be assisted in titration. By watching the color produced by the indicator, the photo-cell can call a halt to the process at just the correct moment. It not only does this, but it rings a bell to report its findings.

Courtesy Bell Telephone Laboratories

The vacuum-tube amplifier plays a vital part in the audiometer, which measures noise levels

Human illness and death abide between the rather narrow limits of 7.25 and 7.40 pH (acidity) units. Also, fish die in water that does not have the proper hydrogen ion concentration. These two rather divergent facts are simply mentioned to give the reader some idea of the importance of properly determining acidity, a job which thermionic tubes do with nice precision. The measurement of acidity in the chemical research and industrial routine analysis laboratory is everyday work of a highly necessary character. It must be done rapidly and accurately. The vacuum tube has learned to do it that way. This and the many other things that it is capable of doing in the chemical laboratory leads us to ask the question: "Will automatic analysis put the analytical chemist in the ranks of the bartender and the hansom cab driver?"

In a dark and murky smokestack, a photo-cell intercepts a beam of light from a source on the opposite side of the flue. The amount of light striking the cell will depend upon the intensity of the smoke and the intensity of the smoke will, in turn, depend upon the condition of the fire under the boiler. Draft is the big question and the fireman has only to look at a small meter to know just what his next job is and when to do it. The meter is connected to the ever-watchful cell perched high in the stack where a human would quickly be snuffed out by the death-dealing carbon monoxide. Photo-cells take digits from industrial coal bills.

A few years hence and "Watch your step, please" will be a forgotten phrase in elevator traffic. The photo-cell is now operating an automatic car-leveling control in vertical travel. It is used on all of the new button-controlled cars in the newer buildings. Silence, efficiency and dependability are its characteristics.

Courtesy General Electric Company

A photo-electric cell, on the opposite side of the paper from the light source shown, controls the "register" of the wrapping paper on this packaging machine

ALTHOUGH we are not at war, poison gas still kills many people every year. Certain gases are less transparent to infra-red waves than is air and a photo-cell is able to take advantage of this difference. Indirectly, it is made to "smell." Working on practically the same principle, it can detect a fire and start a sprinkler system or flood the room with carbon dioxide.

The door of the hospital operating room was opened to the thermionic vacuum tube some time ago and here it promises great things in the alleviation of human misery. A special surgical knife or scalpel is so constructed as to be heated by high-frequency currents generated by vacuum tubes. This is not the kind of heat with which we are familiar. In a sense, it is cold heat which acts to seal the capillaries as fast as the knife cuts. Cauterization becomes automatic and bloodless operations are now possible. Not only this, but we find the larger vacuum tubes generating high-frequency currents to produce artificial fevers that assist the body fever in killing the microscopic invaders.

We humans are shell-shocked every day in the street, in the office, and in the factory. The pathological effects of noise on the human is becoming a subject for grave study in this day when neuroses are so prevalent. It is being found that there is a distinct limit to the noise that human beings can bear as a steady diet. The vacuum tube cannot prevent noise, but it can measure it with a new kind of yardstick and find the critical value wherever it may exist. That is already being done with the audiometer, a device which permits us to see in black and white just how much punishment we are taking in noise. At least some of our industrialists are taking the matter seriously enough to have measurements made with the view of protecting their workers from the ultimate pain of unnecessary din and racket.

Courtesy Westinghouse Electric and Manufacturing Company

The grid-glow relay (the vacuum tube on the end of the box) and D. D. Knowles, its inventor

Electron tubes hold out a great deal of promise in the steel industry where they are already used in rolling mills. The photo-electric cell is arranged at the end of the mill in such a way that a billet of steel interrupts a beam of light striking the cell. This, affecting the resistance of the cell, operates relays and finally circuit breakers and switches that reverse the mill, carrying the billet back into its cycle.

ONE of the more obvious applications of the photo-cell is that of counting objects by so arranging a beam of light falling upon the cell, that it is interrupted by the objects to be counted. This is done by simply amplifying the resultant effect and closing a relay, which in turn, energizes an electro-magnet connected to a mechanical counter. Such circuits may be designed to operate at great speed and they are capable of counting much faster than a human can count. Not only that, but they never miss a count.

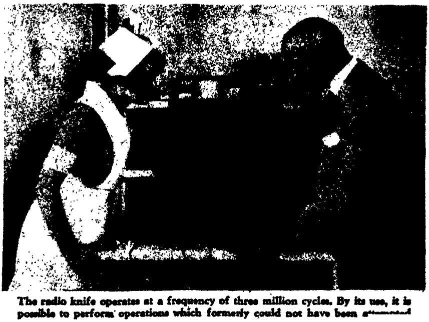
Sorting operations, when they involve different degrees and shades of color, may be carried out by photo-electric cells. It is now part of the everyday work of the photo-cell to sort out odd beans or peas, or to grade cigars according to the most delicate differences in color, a job that was once entrusted to only the most highly trained experts. The principle used is a very simple one. It depends entirely upon the amount of light reflected by an object and this, in turn, depends upon the color or shade of the object. The circuits developed for this purpose have been so highly perfected that shades may be distinguished and classified that could not be so arranged by any other method, if it had to meet the test of speed.

The method of color and shade classification outlined above has also been used in the preparation of wrapped package goods. Boxes that are improperly wrapped are detected and removed from a traveling belt. In such cases, the photo-electric sentinel replaces one or more workers and its work is done at very small cost. The upkeep for such equipment need not run over 25 to 50 dollars a year. A good example of this type of photo-electric cell operation is illustrated on page 239. Here the application is to a yeast-cake wrapping machine.

Perhaps one of the most valuable services performed by the all-seeing cell is that of keeping watch over the generating equipment in large power plants. Disastrous and costly flash-overs in high-voltage systems not only cause interruptions in electric service but also do great harm if they are not promptly extinquished. Photo-electric cells placed at points where flash-overs are most likely to occur now make it possible automatically to cut off the power source at the instant the flash-over develops. The brilliant light caused by these accidents to power equipment is "seen" by the cell which promptly closes a train of relays and opens circuit breakers to prevent further damage.

PHOTOMETRY and pyrometry have supplied two legitimate fields for the photo-cell. In the photo-cell the illuminating engineer has found an invaluable aid in the measurement of light from direct and reflected sources. Research in connection with the design of electric lights has found a tool of vast importance in the photo-electric cell. Not only this, but it also supplies a valuable check on the manufactured article. Greater perfection has also been possible in the art of pyrometry, advantage being taken of the intensity of light as an index to temperature. In such apparatus, a milli-ammeter connected to an amplifier output circuit of a cell is re-calibrated in light units.

And so runs the story of electronic devices in art and industry, a story that has made only a modest beginning when the adaptability and versatile nature of electronic devices are taken into consideration. There are many things still to be done and it may be many years before vacuum tubes have been introduced to all of the jobs they are capable of doing.



The radio knife operates at a frequency of three million cycles. By its use, it is possible to perform operations which formerly could not have been attempted

A NEW USE FOR RADIUM[1]

By ROBERT F. MEHL, Ph.D.

Superintendent of the Division of Physical Metallurgy
Naval Research Laboratory, Washington, D. C.

ONE day, early in September, 1916, several scows floated down the St. Lawrence River bearing the last section of the mammoth new cantilever bridge, the Quebec Bridge. The scows were carefully guided into place and the last section, a span of 640 feet, attached to lifting girders which were to hoist it by steps into place. This technique was new in bridge building, but a highly capable corps of engineers had laid its plans with great care, and as the section rose slowly from the scows the task seemed successfully accomplished.

Without forewarning the section broke away from the lifting girders and sank into the river. Subsequent study disclosed the fact that a steel casting, an integral part of the rocker-joint support between the span and the lifting girders, had given way.

No one was at fault. The casting had been made by a reputable company, it had satisfactorily passed its inspection tests for chemical composition, strength, and ductility, yet it contained hidden defects and failed, and its failure resulted in the destruction of 11 lives and in the loss of a million dollars.

LATE last year a 10,000-ton cruiser was built for the United States Navy in one of the country's finest shipyards. It had installed upon it a nine-ton steel casting known as the sternpost casting. This casting was just forward of the rudder and bore at the bottom the bending moment, though not the weight, of the rudder. It also appeared to be a perfect casting upon leaving the foundry. During first trials of the ship, however, two cracks opened in the casting, which were promptly welded when the ship went into drydock. The welds were excellent in appearance and it was fervently hoped that they corrected the only defects present in the casting. Naturally this could not be certain and it was important to have some real assurance on the point. Accordingly representatives of the division of metallurgy at the Naval Research Laboratory were requested to apply the radiographic method, newly developed at the Laboratory, to the questionable piece. In all, 24 areas measuring 10 by 12 inches, were photographed, but the information obtained concerning the inner condition of the casting was far from reassuring. Besides a number of sections exhibiting voids and general porosity at least 20 cracks were found, from an inch to 20 inches in length.

The ship put to sea for its final trials and during the tests the casting split nearly in two, with the direct result that the ship is now laid up in drydock and about 200,000 dollars will have to be expended in replacing the casting.

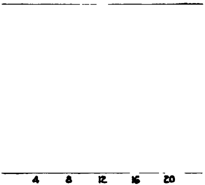


Figure 1: Decay curve for radon

These two examples are chosen because they illustrate in a striking way the thesis of this article: it is highly probable that neither of these two misfortunes would have occurred had the castings first been subjected to radiographic inspection.

The art of taking shadow pictures through opaque objects, the art of radiography, is very nearly as old as X rays, for Roentgen himself practiced it somewhat shortly after discovering the X ray. It makes little difference, so far as the X ray is concerned, whether the object to be radiographed is an arm with a broken ulna, a tooth with a suspicion of an abscess, or a steel casting of questionable quality; the result is always the same in principle. Those parts which absorb the ray the more strongly—with a higher absorption coefficient—leave upon the film a light area outlining the peripheral characteristics of the parts, while voids or less absorbing parts leave dark areas on the film. The result is a photographic film or plate delineating the internal (absorptive) characteristics of the object, a *radiograph* from which may be read the necessary information.

Medicine immediately recognized the importance of radiography, and industry followed soon after. The industrial application of radiography is the concern of this article, particularly by the use of—not the X ray—but the gamma ray from radium. Before itemizing the distinguishing characteristics of gamma-ray radiography the field of industrial application should be viewed briefly.

Metal structures are designed by the engineer to withstand calculated stresses. The uncertainty of calculation and of unseen exigencies lead the engineer to design with a "factor of safety"- made to withstand stresses several times those calculated. Such a procedure is permissible if the strength of the materials used is known. But for all metal structures some uncertainty in the dependability of the material obtains. This uncertainty is relatively unimportant for forged and rolled structures, such as structural members, I-beams, rails and so forth, but is especially acute for welds and steel castings. Both of the latter may contain hidden defects which dangerously diminish their strength. The welder does not always produce a solid weld, nor does he always get perfect fusion between the object and the metal from the welding rod. The foundryman does not always produce a steel casting of solid metal,

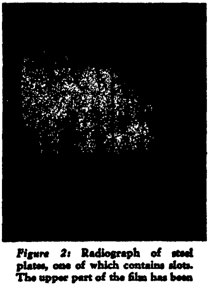


Figure 2: Radiograph of steel plates, one of which contains slots. The upper part of the film has been protected from gamma rays striking objects to the rear of the film and reflecting back to the film by a lead sheet which absorbed them. This part of the film is accordingly considerably lighter than the other

free from gas holes, shrinkage cracks, and sand inclusions.

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[1] Published by permission of the Navy Department, Washington, D. C.

In such cases a non-destructive method of test—a method which does not destroy while it tests—is of great importance. Magnetic and electrical methods have been very satisfactory for materials in rod or sheet form which exhibit an approximately constant cross-section, but for welds and castings the radiographic method holds the preëminent place. It permits the manufacturer to ascertain the quality of his product, but—more important—it also permits him to study his method of manufacture by the intimate record of hidden faults it provides, so that the method may be improved to eliminate the faults.

X-ray radiography is now used in industry in both of these ways. It has been a constant guide in the development of welding technique, which bids fair to become one of the industrial triumphs of the present decade. It is now regular routine in the inspection of cast aluminum pistons in the shops of America's largest producer of aluminum. It has been successfully applied to detecting mis-alinement in the elements in radio tubes and eccentricities in the cores of golf balls. It has clearly pointed the way toward improvement in steel castings practice, especially in the hands of Dr. H. H. Lester at the Watertown Arsenal.

THIS latter application is perhaps the most important and deserves a few comments. The problem of casting a complicated shape in steel is immensely difficult. The designer of the pattern and the workman who makes the sand mold have accumulated a great amount of valuable experience on the ways and means of producing a casting of good appearance. But it is hard to find a better example of the old adage that appearances are deceptive, for a steel casting might, and usually does, display an excellent surface which promises solid and strong metal beneath, a promise which radiography too seldom vouchsafes. The many and obvious advantages in fabricating structures of steel castings hardly permit the conclusion that castings should therefore not be used. Rather than this, radiographic methods should be used to instruct the [illegible] d foundryman in the correct [illegible] to procure sound castings; this has been the conclusion of many [illegible] and we may confidently ex[illegible] a rejuvenation of the industry upon this basis.

The [illegible]st powerful X-ray bulb now [illegible]trially operates at a maximum [illegible] about 250,000. It produces [illegible]ys of light—with an effective wavelength of about 0.12 Angström units (10^{-9} cm). By its use excellent radiographs may be taken through steel objects ranging in thickness up to about three or three and one half inches. Beyond these thicknesses the time of exposure becomes intolerably prolonged, so that for a thickness of six inches calculation indicates an exposure time of roughly 500 hours.

Late in 1928 the author made arrangements to study the use of the gamma ray from radium for radiographic purposes, and this study was carried out in the summer of 1929 in collaboration with Dr. G. E. Doan, assistant professor of metallurgy at Lehigh University, and Dr. C. S. Barrett of the division of physical metallurgy at the Naval Research Laboratory.

The gamma ray from radium is also a light ray, similar in nature to the X ray and differing only in its much shorter wavelength. The ray emerging from an X-ray bulb, or that emerging from a radioactive substance, is a *band* of light waves, that is, it contains a range of wavelengths. There is no difference in these two rays except that of wavelength. Nor is there any other difference between these two rays and other more familiar light waves, the ultraviolet light of much interest to the medical profession, blue, green, yellow, and red light of the ordinary variety, heat radiation, and radio waves. They

Figure 3: **Radiograph of a monkey-wrench, showing the definition obtained**

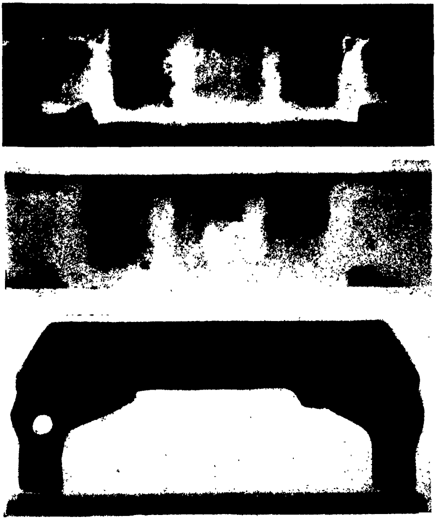


Figure 4: Top; **Radiograph of a steel casting (the one shown at the bottom) made by gamma rays and,** *center,* **the same one by X rays, showing sand inclusions**

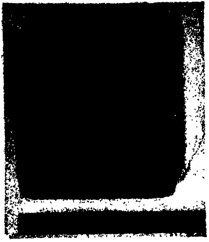
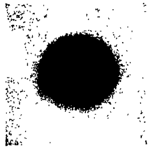


Figure 5: Above; Block of cast iron with large hole leading off one face. Assembled after cutting. *Right;* Radiograph of casting shown above. *Below;* Cast-iron block cut to show hidden defects described in the text



are all light waves, or, as the physicist has ordinarily labelled them, "electromagnetic vibrations in the ether."

X rays of very short wavelength, or gamma rays, are designated as "hard" in contrast to X rays of greater wavelength which are designated as "soft." These terms are used to denote the loss in strength or intensity of the ray in passing through material objects, the hard ray suffering the smaller loss in intensity. The loss in intensity is thus dependent upon wavelength, and for this reason the gamma ray suffers the least diminution in intensity of any of the above named rays in passing through matter. It is obvious, then, that gamma rays should be useful in radiographing thicknesses of steel beyond the range of the X ray, provided satisfactory radiographs could be obtained with reasonable quantities of radium.

For the purposes of radiography either radium or its first product of decomposition, radon (radium emanation), a gas, can be used. It is now common knowledge that radium decomposes spontaneously and forms a sequence of chemically different elements of which radon is the first and lead the last. During these atomic transmutations three types of rays are emitted, the alpha ray composed of fast-flying helium atoms with a double positive charge, the beta ray composed of fast-flying electrons, and the gamma ray. So far as the gamma ray is concerned, radium and radium emanation are equally effective.

Practically there are some properties of the two elements to be borne in mind. Each radioactive element loses its radiating strength progressively with time, following a logarithmic law (Figure 1). Since the *rate* of disappearance progressively decreases (Figure 1) and never reaches zero it is impossible to speak of the "life" of a radioactive element. The period of time during which the radiating strength of the element decreases to *half* the original strength, however, the "half-life", is known accurately for most of the radioactive elements. For radium the half-life period is 1560 years, for radon 3.85 days (Figure 1).

Radium, then, forms radon at a nearly constant rate. Radon in turn forms the next element in the sequence at a much faster rate. It is the custom among the doctors who use radon for the treatment of cancer to pump the spontaneously formed radon from the radium each day and to seal it in very small glass capsules. These capsules accumulate day by day, but lose in strength according to the curve given in Figure 1. Except for small losses in the pumping operation the radiating strength of the accumulated capsules is the same as that of radium from which the radon had not been removed.

Since only the gamma ray is of interest and since the alpha and beta rays have especially harmful physiological action, the latter rays are purposely cut off by a tightly fitting metal capsule surrounding the small glass bulb. Thus we may use capsules, roughly the size of a pea, containing either radium or radon, and expect equal photographic results when quantities of equal radiating strength—measured in millicuries*—are used. If radon is used some correction must be made upon the exposure times in order to account for the fairly rapid loss in strength of the radon with time. The gamma ray, like the X ray, also has a harmful physiological action, but if the radioactive material emmitting the gamma ray be kept in a lead box, handled only with tongs, and if the operator absent himself promptly when the exposure is started, no danger is incurred.

The apparatus necessary to take radiographs with gamma rays is gratifyingly simple; it consists merely of a small capsule containing the radiographic substance, and a film holder containing the film on enhancing screen to accelerate photographic action.

THE data necessary are those relating the strength of the radioactive source, the distance from the source to the film, the thickness and nature of the object to be radiographed, and the time of exposure. These data have all been obtained. It is frequently found that over-night exposures are the most suitable, and the following table has been prepared upon this basis, showing the initial strength of radium and strength of radon in millicuries required for an over-night exposure (15 hours) at a distance of 18 inches.

Figure 6: An arrangement for multiple radiography. Where circumstances are suitable still a [illegible] work can be done simultaneously from one capsule

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*Millicurie, the quantity of radon liberated from one milligram of radium.—*Ed.*

Thickness of Steel in Inches	*Strength Radium*	*Strength Radon*
1	12	13
2	28	30
3	66	70
4	142	150
5	298	315
6	667	704

These may be taken as basic data from which any other desired may be calculated. If one inch of steel is to be radiographed, 120 millicuries of radium will accomplish it in one tenth the time of 12 millicuries, and so on. If the distance from source to film is other than 18 inches, the intensity will vary inversely as the square of the distance.

These data refer to a film density of 2.20—a density sufficient to bring out defects—voids—of only two percent of the total thickness of the piece. Figure 2 is an illustration of this sensitivity. This radiograph was prepared from a pile of six steel plates each 12 inches square and approximately ⅝ inch thick standing perpendicular to the gamma-ray beam with the film behind them. One of the plates, inside the pile, carried a series of slots of varying depths and widths. The smallest of these slots, shown by the shadow "3", was 1 millimeter wide and 2 millimeters thick, 2 percent of the total thickness.

THE definition obtained by the use of gamma rays may be seen in Figure 3, a radiograph of a wrench 8½ inches in length.

The contrast obtained on gamma-ray films is not so great as that on X-ray films. This does not constitute a disadvantage, as we may see from Figure 4, which shows two radiographs of the small steel casting shown at bottom taken by X rays and by gamma rays. Each small defect visible upon the X-ray film may also be found upon the gamma-ray film. But a new advantage appears in the gamma-ray film; the irregular sections are all correctly exposed, whereas to accomplish this with the softer X ray requires doctoring the specimen with lead sheets, special plasters, or liquids, to reduce the effective irregularity.

Figure 7: **Arrangement for radiographing a large cylindrical casting. The radium is held on a stand inside and the films fastened outside around the circumference of the casting in two parallel belts. See text in the column below**

Figure 8: **Radiograph of a bronze valve casting nine inches high, free from defects. Note shadow of threads**

The table of exposure data does not list thicknesses greater than 6 inches. Quite satisfactory radiographs have, however, been taken of thicknesses up to 10½ inches of steel and even thicker sections could be handled, given sufficient radium and a sufficiently long exposure time. Figure 5 shows a cast-iron block 8 by 10 inches, and its radiograph through the 8-inch section. The large hole apparent in the photograph is clearly shown in the radiograph, but besides this we may discover a cloud-like effect floating over this large dark circle. This proved to be caused by a large void near one side of the casting, as shown by the photograph of the cut-up block.

With X rays but one or, at the most, very few objects may be radiographed at one time. Furthermore, a large object must ordinarily be transported to the X-ray apparatus. With gamma rays an entirely different technique is possible. The radioactive source radiates in all directions, spherically, and a large number of objects may be placed around the radiating source for simultaneous radiography. This feature tends to equalize the exposure time characteristic of the two methods, since the exposure times are longer in gamma-ray radiography. Figure 6 shows an arrangement for taking four radiographs simultaneously, but this number could easily be greater. In addition the apparatus for gamma-ray radiography is entirely portable and therefore useful in many applications where X rays are not. Figure 7 shows a typical arrangement for the radiography of a very large casting "in place," that is, not disturbed in its original position. This feature of portability made possible the radiographic inspection of the stern-post casting mentioned at the beginning of this article.

Radiography finds no application in industry more important than that of the inspection of valves and pipe fittings for the construction of modern high-temperature high-pressure steam power plants. The failure of an important part of a steam line might result in the loss of tens of thousands of dollars, in the stagnation of the community source of power, and very probably in a loss of life. In such an application the cost of inspection is hardly an item to be reckoned, and quality is paramount. The pressures used in such plants are steadily being increased, and have already reached the point where the valves and pipe fittings required are so thick that X-ray radiographs can not be taken of them. It is a fertile field for the use of gamma ray with its greater penetrating power. A radiograph of a small casting of this type is shown in Figure 8.

ALTHOUGH the use of gamma rays in radiography is new it has already found some practical use. It is at present rather difficult to say what the extent of its industrial use will be. At first sight it may seem to be expensive, but it must be remembered that radium has an extremely long life, its half-life period being 1560 years regardless of how many radiographs are taken with it, and it therefore shows practically no depreciation in value with time. A study of the costs of the method shows that they are much the same as those of the X-ray method.

Telephone messages relating to criminal activities are relayed by radio to other stations of the Michigan state police force through this remote control panel

RADIO GOES MAN-HUNTING

By WM. J. BARKLEY
Vice Pres., DeForest Radio Company

THE present country-wide crime wave is old enough. It has had plenty of time to die but, unfortunately, it has not done so. Perhaps the fact that the crime wave started soon after the termination of the World War caused many to regard it as a reaction of the conflict or caused by the depression and unemployment of 1920 and '21. Had the crime wave been in reality transient affair, we might have had re sons to pay little heed to it. Perhaps ou American optimism has been to blam for the lack of any constructive metho to combat this crime and the continued feeling that it would blow over despite the fact that it has continued to grow for almost ten years.

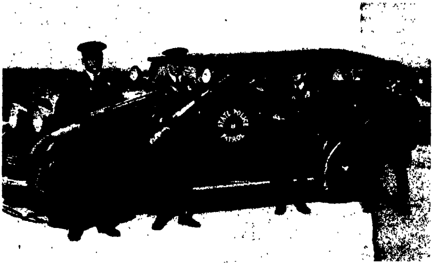
Radio is a new science. It began to blossom forth just about the time that the crime wave did. Since then it has entered many activities of human concern, and so it was not unnatural for radio engineers, some months ago, to seek means to assist in abolishing the present crime wave with the aid of radio. A thorough investigation of the crime situation revealed several startling facts. Fortunately, these facts proved beyond a doubt that radio could be an even greater aid to the police than was previously thought.

In the first place it was learned that crime can be minimized by two methods. One is by stringent punishment of criminals. However, the most severe penalties are of no avail if the criminals are not caught. Any sort of punishment presupposes the capture of the guilty parties. The second method is by making captures so swift and punishment so sure that the potential criminal will consider capture not as an unlucky break but as the natural aftermath of any crime which may be committed by him.

The matter of punishment is in the hands of our courts and legislative bodies. The matter of capture is in the hands of the police.

THE DeForest radio engineers recently set out to find the greatest factor in the escape of criminals after the crime with a view to lessening this factor by radio. It was found that almost every crime, especially in our larger cities, is witnessed by at least one person. Sometimes that person is the victim himself. Unless killed or seriously wounded, the victim is in a position to notify the police immediately after the criminal has departed. Often, he has had a chance to learn the appearance of the criminal, perhaps the make and color or license number of his car. Or, the witness might be a passerby, in no way connected with the crime and in an excellent position to notify the police without physical danger to himself. Or, if the crime is committed in a bank or other such institution, an automatic alarm notifies headquarters that s thing is amiss; consequently, police headquarters is almost always aware of the crime within at least a few minutes after it occurs.

The next step, however, is the faulty one, the one by which the criminal so often escapes. We are saying nothing new in remarking that the greatest element in escape is time. Usually the crime is known immediately. Usually, also, there are people in the path of the criminal's escape. The greatest factor in escape is the time taken for those who know of the crime to impart their knowledge to those in the path of the criminal, who are in a position to give chase. We might say that the first half hour after a crime is more important to the criminal in making his retreat than the fol-



A fully equipped police car ready for any emergency. A radio headquarters serves to increase greatly the effectiveness of such mobile lowing ten hours. Once the police lose the trail, it is extremely difficult to pick it up again. It is this time difference which makes for escape. It is this same time difference that the radio engineers have tried to cut to a minimum.

Before the development of police radio, it was the custom of headquarters, on receiving information of a crime, to phone precinct stations and police booths. Since the modern criminal uses such speedy carriers as automobiles, trains, and airplanes, it is imperative that the chase be commenced quickly and police departments notified not only in the immediate vicinity of the crime but for many miles around. Often it takes several hours for headquarters to communicate by telephone to all the local and sub-stations. And these stations, furthermore, have until recently been unable to get in touch with patrolmen, either on foot or in cars, until they communicated with their local stations, either in person or by phone. It is seldom that the active pursuit of criminals takes place sooner than several hours after the crime has been committed.

NOW, however, through the instrumentality of police radio, the hunt may be begun even before the criminal leaves the scene of his activity, and may be intelligently controlled from headquarters while the chase is on.

The police radio system is both simple and efficient. Essentially, it consists of a transmitter and police car and station receivers. The power of the transmitter depends on the area to be covered. In the case of the DeForest police radio system installation for the state of Michigan, the power was exceedingly high to cover many hundreds of miles. However, for a system involving but one city or a small group of villages the power can be reduced accordingly. Likewise, the number of receivers to be used is dependent on the number of police officers in the community or communities to be served.

The transmitter is installed in police headquarters. The transmitting vacuum tubes are constantly kept at half glow so that they will always be warm and ready for use within three or four seconds. If an operator is on duty in the transmitting room the microphone will be on hand there. Usually there is another microphone on the headquarters desk so that the messages may be transmitted as received over the phone from witnesses of a crime. The receivers are placed in precinct stations, police booths, and police cars. The transmitter is tuned to a short wavelength, outside the usual broadcast band. The police signals in no way interfere with broadcast programs nor do the latter conflict with police reports. It is impossible for the short wavelength signals of the police transmitters to be picked up on the usual home receivers. Thus, there is little fear of police information reaching those for whom it is not intended. The police receivers are tuned to the wavelength of the transmitter and locked there so that no other signals may be picked up.

Test signals are transmitted at frequent and regular intervals, usually every 10 or 15 minutes. During these transmissions such information as missing persons, stolen cars, and the like is given.

With the use of the police radio system the former half hour or several hour gap between the acquisition of information at headquarters and its dissemination to patrolmen is now closed to within several seconds. For as the desk man receives information of the crime over the phone he speaks into the microphone at his desk and immediately all precinct stations, police booths, and police cars are notified. Policemen in the precinct stations may be immediately dispatched to the scene of the crime or give chase. Those in the police booths may commandeer passing cars and the police automobile may cut short the retreat of the criminal.

The use of police radio has resulted in the capture of criminals at the very scene of the crime—even while committing the crime. At other times they have been apprehended a short distance away. In any case, the trail is hot and the chase is on from the very moment that the crime is known. The first vital half hour is no more at the criminal's disposal. Prompt capture makes for easy conviction and imprisonment. If, in the criminal's mind, a crime is associated with sure and speedy arrest he will think twice before plying his nefarious trade in communities equipped with police radio. And his underworld friends will take heed from his arrest and cross such communities off their lists.

Upper:* Headquarters of the Michigan state police at East Lansing. *Lower:* The 5000-watt transmitter installed there for communication with police receivers over a large territory. *It is controlled from the panel shown on opposite page

NEW TEMPERATURE MEASUREMENTS OF THE SUN, MOON, MARS

By HENRY NORRIS RUSSELL, Ph. D.

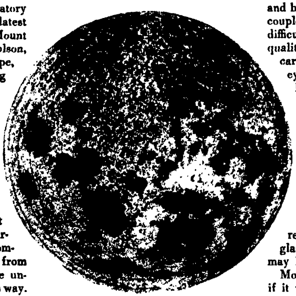
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

THE "cold moonlight" is so familiar a phrase that we almost forget that it belongs to science as much as to poetry. So far as our human senses go the moon's light carries not a trace of warmth. One might as well be in the shadow as in its full glare. But may we then speak of the "cold moon"? This is quite another question and the resources of the modern observatory must be used to answer it. The latest word on the subject comes from Mount Wilson where Pettit and Nicholson, working with the great telescope, have secured some very interesting results.

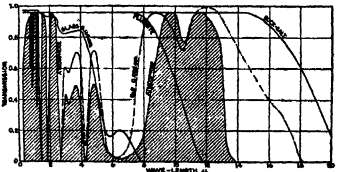
HOW their measures are made has been told long since in these columns (May, 1929—*Ed.*). The great reflector concentrates the heat as well as the light which comes from a star, into its focal image. By placing there a very delicate thermo-electric couple this heat, minute as it is, sets a current flowing in the circuit which is measured by a galvanometer of great sensitivity. The heat from stars too faint to be visible to the unaided eye has been measured in this way.

The moon's heat, though too small to feel directly, is 100,000 times as great as that from the brightest stars and there would be no need of such delicate apparatus if it was desired only to measure its whole amount. But with the large image formed by the telescope it is possible to study the surface in detail, finding out how much heat we receive from any particular spot and how this changes as the sun's rays strike the moon at different angles.

To find the temperature of these various points on the moon is a harder job, for the radiant heat which our instruments record is composed of two very different parts. Of the sun's rays which fall on the moon's surface a part are reflected (otherwise we could not see them) and these reflected rays carry with them heat as well as light. The rest of the solar radiation is absorbed by the moon's surface and warms it up. As the lunar day advances toward its noon the surface must get hotter and hotter. What limits this rise? The outward radiation of heat from the moon itself. All bodies, even those that we ordinarily call cold, tend to lose heat by radiation into the depths of space—faster, of course, the warmer the air—and the moon's temperature will rise till the rate of loss balances that at which heat is absorbed from the sunlight.



Lunar lines of equal temperature



Courtesy of the Astrophysical Journal

In making the measurements described, astronomers take advantage of the fact that different radiation filtering media —glass, air, water vapor and others—will transmit previously known percentages (vertical scale of the diagram) of the available radiation at different wavelengths (horizontal scale) that reaches them. As its curve indicates, the atmosphere's transmission at various wavelengths is very spotty, and so is that of water vapor (marked H_2O). The "tolerably clear path" Professor Russell mentions is the big hump in the curve between about 8μ and 14μ. Glass, however, cuts off the same range. The sun's spectrum, not itself indicated here, begins at 0.3μ and ends at about 5μ. This is the author's "reflected heat" which glass does not cut off (*curve for glass*)

This radiated heat is collected by our telescope, along with the reflected heat, and both together influence our thermocouples. To separate them is not so difficult, for the reflected heat has the quality of the original sunlight. It is carried by the short waves which our eyes can see, and those a little longer, while the radiated heat comes almost exclusively in waves 10 or 20 times as long as those of visible light. A suitable screen, for example a microscope cover glass only 1/150th of an inch thick, transmits practically the whole of the reflected rays and but a very small part of the long-wave radiation which the moon gives out on its own account. By repeating the measures with the glass in place the two components may be distinguished.

Most of the work would now be over if it were not for that bane of all observers, the earth's atmosphere. The air above our heads is very imperfectly transparent, especially to the longer waves. The water vapor in it causes most of the trouble and unfortunately this varies in amount with weather conditions almost from hour to hour. There is only one spectral region, containing waves from 15 to 25 times as long as those of green light, for which the path is tolerably clear. Fortunately these waves are given off in considerable proportions by bodies at the temperatures of the moon and the planets.

For a standard bo[illegible] "perfect radiator," [illegible] given temperature the amount of heat radiated is accurately known and a straightforward though rather tedious calculation shows how much of this heat will run the gauntlet through the earth's atmosphere past the cover glass and reach the measuring apparatus. Our measures tell us how much heat we actually receive from a given apparent area of the moon's surface and by comparison we can find how hot the surface is. The reader may have been alert enough to add, "provided that the moon acts like a standard radiator," and this is a fair criticism. There is good reason, however, to believe that for these long waves a surface of rock such as the moon doubtless possesses would behave pretty nearly in the standard fashion. Less trouble is likely to arise here than from uncertainty as to the exact amount of heat that is lost in coming through the air. The average amount of water vapor in the path of the rays, even in the dry California climate, is enough to make a layer of live steam 50 feet thick (at ordinary atmospheric pressure) and the best existing laboratory measures of the absorption have been made for only a small fraction of this amount.

WHEN the measures were made and reduced the Mount Wilson observers found, as Langley had done many years before, that the surface of the moon under a vertical sun is hotter than boiling water. Their first calculations indicated a temperature of 118° Centigrade but a little more arithmetic showed them if this was the fact the heat reflected from the lunar surface, added to that radiated, would come to about 20 percent more than the whole amount received from the sun. The latter is accurately known, and they concluded that their original allowance for the loss caused by water vapor in the air had been too big. Correcting it they found that everything balanced if the temperature was taken to be 101° Centigrade, or 214° Fahrenheit.

This is the hottest part of the moon. When the sun's rays fall obliquely they are spread out and there is less heat received per acre, while the radiating surface remains the same. Where the sun's rays strike at an angle of 60 degrees instead of 90 degrees the temperature is 88° Centigrade. When the angle is reduced to 30 degrees the temperature falls to 40°, and when the sun is 10 degrees high it drops to –30° Centigrade or 22° below zero Fahrenheit.

Observations made during a lunar eclipse show that the surface cools very rapidly as the sun's rays are cut off. The part of the surface observed was illuminated at an angle by the sun and before eclipse its temperature was 60° Centigrade (101° Fahrenheit). One hour later, when the last rays of direct sunlight had just been cut off, the temperature was –100° Centigrade (that is, –150° Fahrenheit). During the two hours of totality there was a low decrease to –117° Centigrade (that is, –180° Fahrenheit). For a few minutes after the sunlight began to return the cold continued, then the temperature rose steadily and rapidly almost to its original value.

This very rapid cooling shows that the rate of conduction of heat into the moon's interior must be extremely slow. Otherwise the heat stored in the rocks below the surface before the eclipse would leak out again and delay the cooling. Calculations by Epstein show that the conductivity must be far greater than that of any known kind of solid rock, or even of loose sand. Only a very light and porous material such as volcanic ash or pumice would behave as the moon actually does. Though the actual surface gets as hot as boiling water the heating is only skin deep. A few inches down—perhaps only an inch—the temperature has the average value of the month, which is probably not far from the freezing point of water.

Courtesy of the Carnegie Inst. of Wash.
Eyepiece of the thermocouple (much enlarged), with its two tiny sensitive thermo-junctions

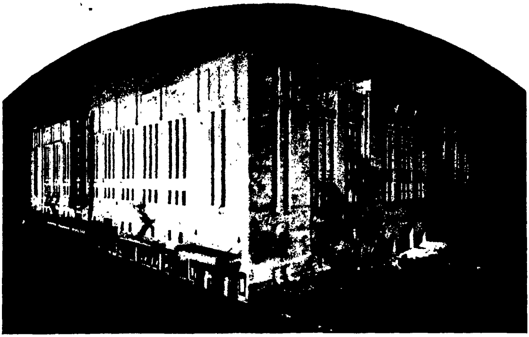
During the long lunar night the moon's surface must grow very cold. Eclipse observations show that within an hour or two of sunset the temperature falls far below the extremes in our worst arctic winters. Later in the long night it must be colder still. Some Mount Wilson measures show that the remaining radiation of heat is barely if at all perceptible, even with the most sensitive apparatus; from which it follows that the surface temperature is below –150° Centigrade, or at least 240° below zero on the Fahrenheit scale.

Exposed to this tremendous range of about 450° Fahrenheit every month, masses of solid rock on the moon's surface would split and scale off at the surface till they were buried in their own debris. There is abundant evidence that the surface is actually rough in detail, darkened by shadows except when we look at it right down the path of the sun's rays, as we might expect.

The new information about the transmission of heat through moist air, which is a by-product of the lunar observations, leads to some change in the temperature previously computed for Mars and the other planets. A new reduction of the observations indicates that the temperature at the surface of Mars, with the sun overhead, is 18° Centigrade or 60° Fahrenheit when the planet is nearest to the sun. The temperature at the pole, toward the end of the long summer, should be about the same. The conclusion that the polar caps are composed of snow and actually melt (or evaporate) in summer still stands.

PLACING a thermocouple behind a small pinhole, and mounting this in the focal plane of the tower telescope used for studies of the sun, the heat received from a small region in the dark center of a sun-spot could be compared with that from the undisturbed photosphere outside. It was found to average 47 percent of the latter, different spots agreeing closely. The total radiation from a standard radiator varies as the fourth power of the temperature, so the temperature of the spot should be 83 percent that of the photosphere. Taking the latter as 5955° K., or "absolute," (on the Centigrade scale, above the absolute zero) the spot comes out 4920°. This probably is a little too high, as some ordinary sunlight scattered by the sky and in the instrument is mixed with the radiation from the spot itself. Observations on the sky just outside the sun's edge indicate that this scattered light was about four percent of full sunlight. For a sun-spot which has bright photosphere all around it, instead of on one side only, the scattered light should be twice as great. This indicates that the real radiation from the spot is 39 percent that of the photosphere, corresponding to a temperature of 4700°.

Two other ways of determining the temperature were available. From observations of the percentage of spot radiation which was cut off by a water cell (which blocks the long waves) the temperature came out 4720°. From the spectroscopic study of the amount of energy in the spot spectrum at different wavelengths ranging from the ultraviolet far into the infra-red the derived value was 4750°. This is considerably higher than had previously been assumed but the excellent agreement of the three determinations inspires confidence in the result, and we are safe in concluding that sun-spots are about 1200° colder than the rest of the disk. The temperatures here given apply to the center of the sun's disk, where we are looking straight down into the gases of the atmosphere and can see deeper and hence to hotter layers on the average than when our line of vision is oblique. For an average of all over the visible disk we do not see down so far, and the photosphere temperature is 5740°. That for the spot is 4530°—still 1200° colder than the other.



The Chicago Stadium presents an imposing, beautiful appearance

CHICAGO'S 'MADISON SQUARE GARDEN'

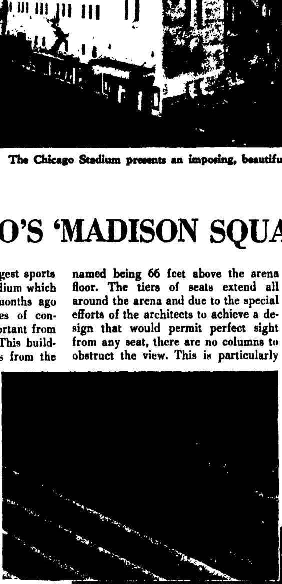
LISTED as the world's largest sports arena, the Chicago Stadium which was completed some months ago has several unusual features of construction which make it important from an engineering standpoint. This building, located about two miles from the business center of the city, is 300 feet long and 266 feet wide with a height of 117 feet, 6 inches at the high point of the roof. The arena is 245 feet long by 145 feet in width and has a clearance of 88 feet to the roof. The Stadium has a total seating capacity of 22,836 and after removal of temporary seats from around the first arena, there are approximately 16,300 permanent seats remaining.

The most important structural feature of this building is the wide-span roof. It is made up of 13 huge steel trusses each having a span of 261 feet 9 inches from center to center. Each of the trusses is 26 feet deep at the center and 13 feet deep at the end. The two center trusses weigh 105 tons each and the remainder are each 90 tons in weight. The entire roof has a total area of 80,000 square feet. Its construction is of pressed steel insulated by a one-inch thickness of cork.

Above the main arena floor there is a mezzanine floor and a first and second balcony, the highest seat in the last named being 66 feet above the arena floor. The tiers of seats extend all around the arena and due to the special efforts of the architects to achieve a design that would permit perfect sight from any seat, there are no columns to obstruct the view. This is particularly important because of the nature of the exhibitions and performances which will be given in the Stadium.

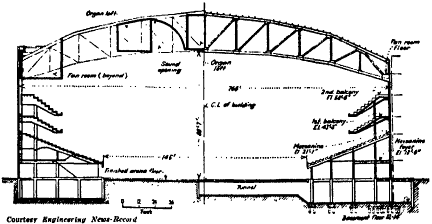
Facilities to meet practically every demand have been incorporated in the Stadium. In the basement are a kitchen, and locker, dining, dressing, general storage, animal, and boiler rooms, and the refrigerating equipment. The area under the arena itself was not excavated.

While the structure in itself presented many problems, the mechanical equipment and the engineering entailed some very special considerations. In visualizing the heating and ventilating problems, the engineers had first to contend with the fact that this building has many diversified requirements in all fields of



Courtesy Carrier Engineering Corporation

Center: Brine piping covered with concrete fill, showing wire netting reinforcing ready for finished floor. *Bottom:* The house is packed for a hockey game

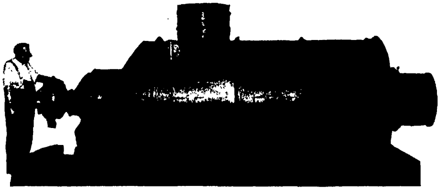


Courtesy Engineering News-Record

A transverse typical section of the new building, showing the organ loft and

sport. There is, for example, the question of heating. For hockey matches the temperature throughout the entire seating area should not be above 60 degrees, while for other events such as a six-day bicycle race or a basket-ball game, the mean temperature should be 70 degrees.

The engineers solved this problem by heating and ventilating the entire stadium with four huge air conditioning units, one mounted at each corner of the building. Each of these supply units is fully equipped with spray type dehumidifiers, re-circulating spray pumps and motors, Aerofin heaters, tempering heaters, and automatic controls for both temperature and humidity. The general offices and other departments located on the street level are independently ventilated by separate supply and exhaust systems located in the basement and equipped with spray type system for air washing. Steam which is supplied to the direct radiation system and to the Aerofin is in reality exhaust steam from the two steam turbines which drive the centrifugal refrigeration machines.



Courtesy Maxcy-Barton Organ Company

The Stadium organ blower, the largest of its kind ever built. It is driven by a 100-horsepower electric motor and is located in a special fan room under the roof

The refrigerating equipment consists of two machines each having a normal rating of 120 tons when cooling brine to low temperatures. At higher temperatures they develop as much as 330 tons each. Provision has been made for the installation of a third machine later.

The refrigerating equipment is not only a necessary part of the air conditioning system, but also serves to freeze the ice surface on the arena floor for hockey matches. Underneath the terrazzo surface of the arena is imbedded a maze of 1½ inch brass piping totaling 85,000 lineal feet. These pipes are laid parallel to each other and across the floor on four inch centers and are entirely covered with metallic concrete and then the terrazzo. Beneath the piping there is one inch of sand and a solid four-inch layer of cork, all supported by a concrete foundation.

By forcing cooled brine through these pipes, the floor surface above is cooled so that as the latter is sprayed with water, a sheet of ice forms. Continued applications of water are then made until the ice is of the thickness required. The entire oval arena or any portion of it can be coated with ice in this manner.

After an exhibition requiring an iced floor, the ice is removed simply by warming the brine circulating through the floor pipes until the bond between the ice and the floor is broken. The ice is then plowed up and removed to a pit in the basement which is equipped with steam coils and a number of drains.

The Chicago Stadium is the first building of its kind to have a modern organ to provide a suitable musical background for all the varied entertainments. The full volume of this organ is equivalent to that of 25 complete brass bands of 100 instruments each, or a total of 2500 orchestral pieces.

A real problem confronted the Maxcy-Barton Organ Company in the design and construction of this great reproducing instrument. They realized that an organ of the capacity required had never been built anywhere in the world before. It was concluded that the tremendous amount of mechanism required for such an organ, together with the many thousands of pipes, would require the building of no less than five organ lofts, and it was decided to locate these in the very center of the auditorium, suspended from the truss work of the roof. These lofts were set in a circle surrounding a specially designed and constructed mixing chamber which, because of its acoustic qualities, blends the tones emitted from the instrument lofts before they finally pass on to the vast space beneath.

Courtesy Carrier Engineering Corporation

The two Carrier centrifugal refrigeration units for cooling the brine used for coating the arena floor with ice and for the air cooling and conditioning system

BUTTERFLY FARMING

By ADELINE TAYLOR

IN Iowa, where the tall corn grows, there is a young man who farms in a different line—he is a butterfly farmer. Irvin Schlesselman, an 18-year-old youth of Cedar Rapids, has hatcheries, traps, displays, and a well established butterfly business. And they are all products of his own ingenuity.

Butterfly farming consists of more than putting a caterpillar in a cage and then coming back two or three months later to find the butterfly. Irvin is raising 30 different species of moths and butterflies, each of them requiring a separate compartment in his hatchery.

THROUGH a hole in the floor of every caterpillar's home a branch of food leaves is inserted. Every worm has a particular menu, and requires his own kind of leaf for breakfast. Through experiment and observation this young farmer has discovered that the Luna moth prefers the walnut tree; the Yellow Emperor thrives on the box elder; the Cecropia likes cedar and lilac leaves; Polyphemus craves weeping birch; the Io wants willow leaves and the Promethea takes to wild cherry foliage. The leaves are kept fresh by standing in a glass of water which must be changed each day. The temperature of the nursery must be watched, so that it does not get too warm after the caterpillars have spun their cocoons—otherwise they will hatch prematurely. Among the cocoon-spinning varieties of moths that Irvin is now raising are the Polyphemus, Promethea, Cecropia, Io, and Luna.

Then, of course, there is the problem of catching the butterflies and moths of many kinds to begin these hatcheries. Again the ingenuity of this unusual farmer came to the rescue and he has designed a trap in which he can catch them. A female is put in a wire cage in the center of the trap, which has five entrances, each of them lined with tin. The male moth is attracted to this trap evidently by his sense of smell.

When the moths land on the tin troughs, their feet will not stick to the surface and they slide into the trap. This tin slide idea was developed by Irvin through a process of experimental elimination—aluminum and other metals, and even painted tin, were used with no success.

Crude but effective homemade trap with which the young butterfly farmer catches the adult insects

The youthful farmer has also attracted moths and butterflies to his traps by brushing a mixture of syrup and vinegar on nearby trees and by tying a female near a trap with a slender thread. He says this latter method often attracts as many as 30 adults.

One of the glass-topped trays made with butterflies raised by Irvin

His hobby competes with amateur astronomy in turning its followers into nighthawks. The Luna moth—that lovely green night traveler that looks like a fairy trailing a phantom train—can be caught about midnight. The same hour is the favorite for the Polyphemus, also, but he who catches the Cecropia must look for him about 3:30 A.M.

Sometimes these moths can be caught around street lamps at night. And a carnival is an ideal place for the moth collector, according to Irvin. The Yellow Emperor is particularly fond of the bright night lights. Butterflies belong to the sunshine and the collector finds them while on daylight walks through fields and meadows.

Irvin and one of the cases of the butterflies that he has collected

Occasionally the hunter goes scouting for cocoons rather than moths—according to the season of the year. He has learned in what trees to look for larvae and can distinguish between the gold-flecked, jade chrysallis of the Monarch, the brown cradle of the Cecropia, the hanging home of the Promethea, and the leaf-wrapped coat of the Luna.

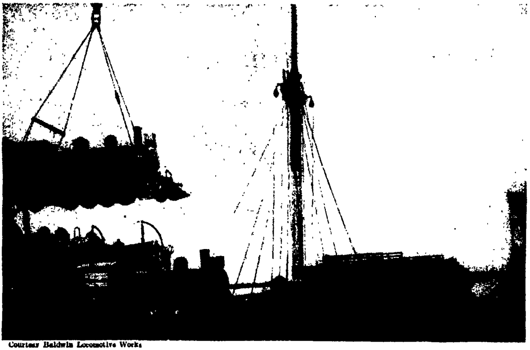
All of this leads toward the end to which all of these efforts have been made—that of having a collection to study and admire and display. And this butterfly farmer certainly has some remarkable results. Over 2000 butterflies and moths have been caught, trapped or raised and eventually mounted in his collection. They include 250 species from his native state alone.

THE case with which Irvin is pictured is one of his own design. The back of it is made of wall board which will not warp and there is a chamber in which to put camphor so that the specimens are kept insect proof. Care must be taken to keep these cases away from strong light so that the colors on the wings will not fade.

Irvin also designs individual specimen cases which are glassed on both sides, enabling the observer to see the under side of the wing.

Irvin has put his butterfly farming on a commercial basis by selling some of the products to other collectors who have been less successful in catching the rarer species. Teachers have been particularly interested in taking advantage of this unusual farm. Another market for these creatures is in making decorative trays and centerpieces, an art at which Irvin is quite proficient.

He is supplementing these displays of 2000 moths and butterflies of this section of the country, which has taken him seven years to collect, with exotic specimens procured from South America and southern India.



Courtesy Baldwin Locomotive Works

With boxed-in cab and headlight, a complete locomotive is loaded aboard ship

WHEN LOCOMOTIVES GO TO SEA

UNTIL a few years ago, ocean shipment of railroad equipment such as locomotives, passenger and freight cars, and the like, involved a system of dismantling and crating at the shipper's port and uncrating and assembly at the port of destination. This system was inefficient and particularly costly in the case of locomotives, large numbers of which are regularly built by American and European manufacturers for railroad companies in Latin-American countries, the Orient, Australia, and Africa.

When a locomotive, built for export, is ready for delivery it must be so complete in every detail that it can be given try-outs and certain prescribed acceptance trials at the manufacturer's plant in the presence of experts sent by the purchaser. If it is then necessary, because ships properly built for this service are not available or for any other reason, to dismantle the accepted locomotive, there is a delay in getting the shipment on its way and a very large expense involved in the crating operations and in loading the various parts separately. Added to this will be another item of expense at the receiving end where the crates must be removed and the locomotive made ready for service. And if, as so often happens, the facilities at this latter port are limited, this cost may be greatly increased due to the long delay.

The advantages of the newer system of shipping locomotives across the seas fully erected are thus immediately evident. Dismantling and crating are obviated but, what is perhaps equally as important, the locomotive can be fired up as soon as it is discharged from the ship and can be driven away under its own power without loss of time. Locomotives made in this country by the Baldwin Locomotive Works are shipped to many foreign countries in this manner.

TO handle locomotives fully erected, as well as other railway equipment and large machinery units, ships specially designed for the purpose are required. A fleet of such ships—the only one of its kind in service today—is operated by Christen Smith, a ship owner of Oslo, Norway. The ships of this line, while relatively small, have specially large hatchways to receive even the largest passenger cars and are considerably stronger and more substantially built than ordinary ships because it is necessary for them to withstand the strains imposed by such immense units of concentrated weight. In them there are no between-decks and no extensive fore-and-aft bulkheads. They are characterized by unusually heavy frames and deck and hull plates.

Since a substantial part of the cargo of these ships is normally carried on deck, their bulwarks, *stanchions*, and coamings have been made exceptionally strong to provide for the heavy lashings. Even so, the ships appear shell-like and fragile to the uninitiated and even top-heavy as shown in our cover painting; but it is asserted that some of them, fully loaded, have weathered the most severe hurricanes.

These ships are relatively short and broad, and due to their light draft can enter some ports that are inaccessible to vessels of ordinary type. All of them are equipped with derricks which have a load capacity up to 120 tons, some of which are operated by electric winches. Other considerations aside, these derricks play an important part in the efficiency of the system because they make possible the unloading of large unit loads in ports where crane capacity is limited or cranes are lacking altogether.

Since the ship's derricks are not very high in proportion to the bulk of a locomotive, ordinary lifting slings such as are used on land would not be satisfactory. Therefore beams of special design are part of the equipment of each of these ships. When one of these beams is placed between the cables of the lifting derrick, parallel to the top of the locomotive or coach, the load is balanced and the cables do not rub the sides of the load. A removable set of beams is provided for the larger ships so that two tiers of cargo may be stowed within the vessel; and provisions have been made for carrying two tiers on deck.

A load of locomotives, railroad coaches, or large units of machinery can not be stowed as simply as bags, boxes, or bulk cargo, so it is necessary to plan beforehand not only the order of loading the units but their exact position on the ship, the necessary lashings, and so forth.

A MACHINE AGE 'MILK MAID'

By JAMES A. TOBEY, Dr. P.H.

WHEN Thomas A. Edison pressed a button at his home in West Orange, New Jersey, on November 13th, 1930, he set in motion at Plainsboro, New Jersey, the world's first "Rotolactor," a part of the new rotary combine milking system which consists of an automatic device for the rapid, efficient, and sanitary milking of many cows at a central place. The rotolactor, which is the main feature, is an ingenious machine for the continuous milking of cows at the rate of 50 in 12½ minutes, or 240 per hour. By thus bringing the animals to the milker instead of taking the milking operations to cows distributed in many scattered barns, labor is saved, production costs are reduced, and, of great significance from the standpoint of hygiene, all possible human contact with the milk is eliminated.

The rotolactor is a circular platform, some 60 feet in diameter, with an outer concentric circle approximately 8 feet in width, which is provided with stalls and stanchions for 50 cattle. The machine is housed in its own new building on the extensive Walker-Gordon farm at Plainsboro, and is connected with the cow barns by covered passages. Above the central part of the rotolactor is a stationary gallery, hermetically glassed-in, where interested spectators may watch the entire proceedings. Also in this building are laboratories, record rooms, and offices, all open for public inspection, a system which is desirable on any dairy farm.

Cows on the rotolactor at the Plainsboro, N. J. a. The cows are milked as the platform turns

As the platform of the rotolactor slowly revolves in a clockwise direction at the rate of 15 feet a minute, the cows come from their stables and approach in single file through a runway, stepping on the platform, one after another, until all the places are taken. Even the stanchions work automatically, closing deftly about the cow's neck as she stands facing toward the center of the rotolactor. By the time the last place has been occupied, the first cow to enter has finished and her place is taken by the next animal in line, so that the operation is continuous.

AN automatic shower bath is the first item on the program. The cows are, in fact, thus bathed three times a day, as milking is conducted thrice daily. Supplementing this shower bath, an attendant washes and dries the udders with sterile cloths, using a fresh one for each cow. The whole ablution process consumes the first 2¾ minutes of the 12½ that the cow remains contentedly on the rotolactor. From the beginning, the animals have adapted themselves to the entire procedure and have displayed no excitement.

Following their baths and cleansing operations, the cows are dried by a current of warm air. A little foremilk is taken by hand for inspection, and then a milking machine, which has just been sterilized, is attached to the cow. By the time the rotolactor has finished its revolution, milking has been completed, with the milk collected in air-tight Pyrex jars. The machines are detached, the stanchion opens automatically, and the cow, realizing that she is finished,

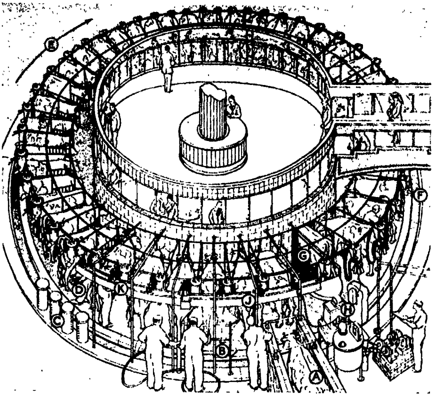
Cows are milked thrice daily. The ablutions occupy the first 2¾ of the 12½ minutes that the cow is on rotolactor

A sterilized milking machine is attached to the c the cow is dried by sterile cloths and a current of w

steps off, follows a runway leading off from the inner edge of the revolving platform (see drawing), and returns to her barn. The whole thing is so scientifically worked out that the cows even traverse a measured distance so that they get the proper amount of exercise walking to and from the rotolactor.

The milk is automatically dumped from the Pyrex jars into a weighing and recording machine and is then conveyed through sterile pipes to the bottling room in an adjacent building, where it is bottled by machine, and aluminum hood caps are automatically put on. At no stage in the whole system is the milk exposed to any possible human or atmospheric contamination. The air in the milking chamber is conditioned so as to give the proper temperature and humidity, as well as complete freedom from dust and dirt. After each use, the milking machines on the rotolactor are automatically rinsed in clean cold water, then sterilized in clean hot water.

PRIOR to admission to the milking line, the milk of each cow undergoes laboratory examination, as does also all milk cited by the foremilker. In addition, the whole milk supply is routinely tested once a week, and the cows themselves are examined at regular intervals by competent veterinarians. Before each milking, a careful inspection of the udders is made, and every animal gets a thorough physical inspection before being admitted to the milk line. The employees are likewise given complete periodic medical examinations, supplemented by the necessary laboratory analyses. A daily medical inspection is made of all workers, so that every possible precaution is taken to guarantee a safe, dependable milk supply unmarred by any possibility of contagion.



Operation of the device is as follows: A—Cow steps on platform; [illegible] washed in part automatically; C—Cows dried; D—Milking apparatus attached; E—Platform moves 15 feet a minute; F—Teat cup taken off; G—Stanchions released allowing cows to step off platform and return to the barn; H—Milk dumped automatically, weighed, and piped to bottling room; J—Milking apparatus washed with cold water; K—Milking apparatus sterilized in hot water and then cooled by cold water. Fifty cows are milked in the space of twelve and one-half minutes. Visitors view the operation through glass windows inside the circle

The rotolactor is not the only unique machine at the Walker-Gordon farm. Several years ago there was devised a feed dehydrator for drying and preserving the green feeds raised during the summer months. As now used, this dehydrator consists of a metal tunnel 40 feet in length and 7 feet in diameter, which is slowly revolved. At the receiving end, set about six inches higher than the discharging end, is an oil-burning furnace and heat chamber. Green forage is run through a chopping machine and then into the dehydrator, from which it emerges as dry feed. The temperature used does not adversely affect the nutritive properties.

The dehydrator is 40 feet in length and 7 feet in diameter. Green forage enters at one end and emerges dry. At night or when idle it is used for drying manure

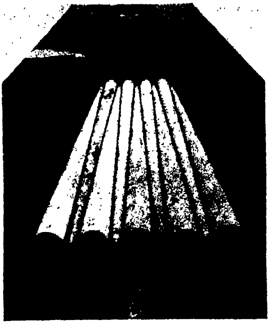
This dehydrator is put to still another important use. When it would otherwise be idle at night, it is employed for the drying of the manure which is usually a serious problem on dairy farms. A separate platform and elevator are installed for this purpose and from it the manure comes out in a dry, pulverized form, free from odor, and valuable as a base for fertilizer.

The development of the rotolactor and of other machines is all part of a general system of centralized direction and decentralized unit operation, that has been evolved under the direction of Mr. Henry W. Jeffers, president of the Walker-Gordon laboratories. Mr. Jeffers himself is the originator of the rotolactor, although it was actually designed and installed by the engineers of the De Laval Separator Company. In the future operations under this general plan, the 1400 dairy animals are to be handled by individual farmers under expert supervision.

CENTRIFUGALLY-SPUN CONCRETE PILES

By L. R. NEED

Westinghouse Electric and Manufacturing Company, Cleveland Works



Compact loading of a railroad gondola with a shipment of the new hollowspun concrete piles

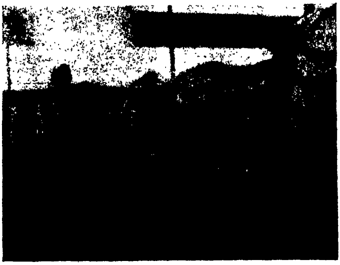
PRESENT day engineers are constantly striving to improve on their handiwork. No sooner is one achievement announced before we hear of plans and projected developments to design and build something better to surpass all previous achievements. The idea seems to be to break all records as fast as they are made.

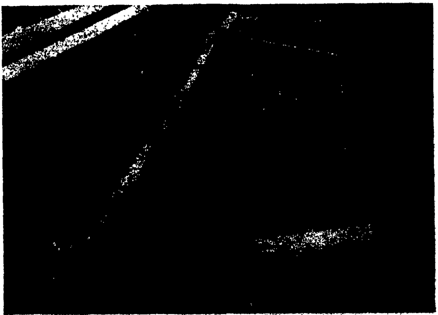
This is particularly true in connection with larger, taller, and more beautiful buildings; longer and more massive bridges to accommodate the ever-increasing traffic; and the like. Such modern structures introduce many phases of engineering which are not familiar or visible to the average layman. One phase is that concerning foundation requirements. Where conditions permit, excavations are made to bed rock which forms a firm foundation for the superimposed structure. But in cases where it is impractical to excavate to bed rock, some other supporting means must be provided. For this purpose various methods are in use, one of which is to support the structure on piles made of wood, concrete, or steel driven into the ground to such a depth that they form permanent supports.

The Westinghouse Electric and Manufacturing Company, who for several years have been making hollowspun granite street lighting standards and trolley poles, have now developed a hollowspun concrete pile. Their engineers have perfected this new pile after intensive research, study, and numerous actual field tests.

These piles are manufactured by the centrifugal process which insures a quality of concrete which is unexcelled as to strength, durability and resistance to fire, water, and atmospheric conditions. These desirable qualities are, of course, very essential in concrete for foundation work. In this centrifugal process, a cast-iron mold is used in which is first placed the necessary reinforcing steel consisting of longitudinal bars spirally wrapped with steel wire. The mold is then filled with concrete and the ends are sealed, after which it is placed in the spinning lathe and revolved at a speed of approximately 400 revolutions per minute for 10 minutes. This lathe consists of a series of rollers on which the mold revolves, the electric driving mechanism being located at one end. The process of revolving the mold is very similar to ordinary lathe operation except that a quick-detachable, flexible connection is maintained between the mold and the lathe face plate to provide an efficient method for setting up the mold and, also, to reduce the wear and tear on the driving mechanism.

This spinning process forces the concrete away from the center of mold and by centrifugal force compresses it against the inside surface thus forming a hollow structure of very dense concrete with the desirable *minimum* amount of water. All excess water is





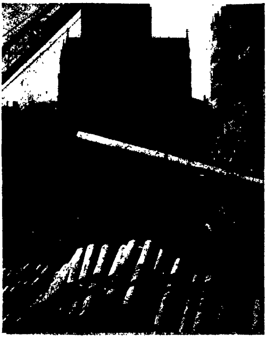
Center: The concrete pile mold on its supporting wheels in spinning lathe.
At bottom: Concrete piles showing capping arrangement for pier foundation.

squeezed toward the center and afterward drained off. After removal of water, the mold is immersed in a curing tank of hot water in which it remains for three hours. At the end of this three-hour curing period, the mold is stripped from the pile and returned to the assembly department for use in making the next pile. The completed pile, if it passes inspection, is now ready for hydration or further curing in a saturated atmosphere. After this second curing process of 10 or 12 days duration, the pile is ready for stock or shipment.

Realizing the importance of obtaining actual data on the strength of hollowspun piles to withstand punishment of the driving hammer and to support the necessary loads, the company proceeded to make a series of tests before placing their piles on the market.

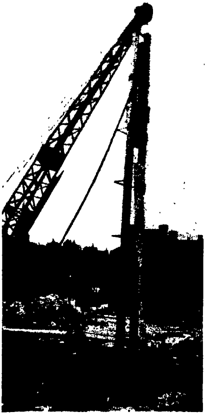
ONE test made at the time this company was having a building erected on its own premises, consisted of driving several hollowspun piles to refusal, that is to bed rock, after which they were removed to a testing laboratory and tested for compression strength. These tests show load values of 200 tons with the piles functioning as columns, that is as point-bearing piles. As the average specifications call for a maximum load of 30 tons per pile, it is evident that hollowspun piles give a high factor of safety when considered as point-bearing piles. When used as friction piles in which the load is carried by the surrounding earth, the supporting power depends to a large extent upon the nature of the soil into which they are driven. There are formulas in common use which determine the bearing power of piles. These are based on the various conditions under which piles are driven, such as type and weight of driving hammer, height of fall of hammer, penetration of pile in inches per blow for the last few blows, and so forth. Hollowspun piles have been driven in different soils in various parts of the country and have been highly praised for their toughness and ability to stand up under very severe punishment.

Under the hammer, a concrete pile "goes home" without any breakage



One of the new piles is lifted from the supply at the site of a new building in Buffalo, N. Y.

Another test to determine the supporting power of a hollowspun pile was made on the site of the new Westinghouse Service Building at Newark, New Jersey. The pile tested was a representative one 28 feet long with a -inch diameter point and 14-inch diameter butt driven into the ground to a depth of 26 feet 6 inches. A platform was constructed and mounted on a steel plate embedded in mortar on top of the pile. Loads were applied on this platform at regular intervals until a load of 60 tons was reached. This 60-ton load, representing twice the working load, was left on over-night for a period of 16 hours 30 minutes, and then removed five tons at a time.



A 35-foot hollowspun concrete pile lifted ready for driving to begin

Settlement readings taken during loading and unloading indicated a net settlement of 3/64 of an inch at 30 tons and 3/16 of an inch at 60 tons. Examination of the pile after this test indicated no cracks or signs of distress.

HOLLOWSPUN piles, like other concrete piles, are driven with standard pile hammers, either single or double acting. As a protection to the top of the piles, cushioning material is frequently placed between the anvil block of the hammer and top of pile. This prevents damage to pile in cases of uneven tops and also where the pile is not kept dead true with the hammer. Various materials such as oak blocks, old manila rope, belting, or hose are used for this cushion.

After driving, preparations are made for capping the piles with concrete. These foundations are then ready to support columns, girders, walls, or whatever is required for the structure to be erected.

Proper engineering in the design and use of piles to meet local conditions will insure firm foundations with corresponding safety and durability. Hollowspun piles are admirably suited to meet the variable conditions encountered in different parts of the country and their adoption by various construction companies is evidence of their reliability.

MASS PRODUCTION OF PRESERVED FOOD

THAT sentiment and business sometimes mix is shown by a little two-story red brick house which nestles in a courtyard in Alleghany, Pennsylvania, surrounded by more than 15 city blocks of imposing factories all devoted to the vast industry that was the direct outcome of the work which was done in a portion of this small house. The little structure was moved on a barge to its present location from Sharpsburgh. It is now an inspiration to thousands of employees and a delight to many thousands of visitors.

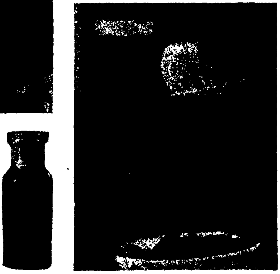
All photographs courtesy H. J. Heinz [illegible]

A "hulling bee" in a food plant. The luscious strawberries will be made into preserves. Home canning cannot compete with mass production

AT the age of eight, Henry J. Heinz began to raise vegetables in his mother's kitchen garden at Sharpsburgh and peddled them among his neighbors from a market basket. The young man was so intrigued by seeing the fruits and vegetables grow, as it were, under his very eyes that he decided to make this his life work. As the boy grew, so did his business and the basket was first exchanged for a wheelbarrow. When he was sixteen he drove his own horse and wagon and had four on his payroll. He sold his produce largely in the neighboring city of Pittsburgh. Still he was not satisfied and in 1869 he began his vast enterprise by grating, preparing, and bottling horseradish in the little red brick house at Sharpsburgh. From this humble beginning there are today 25 factories, 258 salting houses, and raw products receiving stations having an aggregate floor space of 130 acres. The plants use the product of over 200,000 acres harvested by 200,000 people.

Entering one of the factories, the visitor is struck by the order and rigid cleanliness which prevails, and by the interest which the employees seem to take in their work. This staunch solidarity was induced originally by the personal influence of the founder who had an extraordinary gift of inspiring his associates. Even when success had crowned his efforts and the plant waxed large he thought nothing of taking off his coat and showing a laborer a better way of loading bricks on a wheelbarrow.

The experimental kitchen with its staff of chefs is constantly devising new subtleties of flavor and a committee of trained experts passes on their work and also sees that standards are maintained. It must not be supposed that all the work is done in one location. Plants are scattered all over the country and even to Seville, Spain, where olives are bottled and olive oil is produced. It is impossible to describe all the varieties of food products; the mystic number "57" never grows less, but no products are added unless the public taste ap-



Hand packed pickles always display the same pattern. Great skill is necessary in placing the pieces

Preserving room has a battery of silver-lined copper kettles heated by steam. The kettles are double jacketed so that there is no danger of scorching the contents proves. It is indeed a wonderful advertising slogan.

The preserving kettles are silver-lined and are heated by steam. All the operations are carried on with a strict temperature control. An interesting process which always attracts visitors is the canning of the lowly bean. Moving belts charged with beans glide between rows of keen-eyed girls who pass only those beans which are perfect. Then they are baked with dry heat, put in cans and the sauce and the pork added to those cans which are not "vegetarian."

Equal care is devoted to the preparation of spaghetti, a food which is peculiarly sensitive to atmospheric conditions. All the air which enters the spaghetti department is filtered. Fine Durum wheat flour is mixed with water and the dough is mechanically kneaded, after which it is extruded into strands by a powerful hydraulic press. These strands are "bobbed" or cut to equal length and are then placed in a drying compartmei Finally the dry spaghetti goes to the kitchen where it is cooked and canned and a blended sauce f cheese and tomato is added. In he manufacture of tomato catsup, kitchens have been established in the region where the tomatoes are grown, so that they may be converted into catsup while still in prime freshn

Top: The beans are all sorted by hand, passing the keen eyes of several girls before they reach the oven for baking. *Above:* The bean filling rigs put the beans in the can. *Left:* Placing the pork on the baked beans

Salting houses are located in the centers of cucumber raising districts. The cucumbers, immediately after being picked, are salted and then transported to one of the larger establishments in specially built cars. Vinegar is aged for months in huge wooden tanks to develop a flavor, for vinegar has other qualities besides sourness. Having the pickles and the vinegar, packing proceeds. Few people realize that bottles of plain and mixed pickles are all packed according to a definite plan. It is fascinating to watch the skill with which the expert pickle packers develop the pattern in the bottle. Rigid inspection assures that every pickle has its established position in the bottle. Every bottle of mixed pickles is arranged in the same pattern.

Spaghetti production. *Left:* The Durum wheat flour is mixed with water, kneaded, and forced into strands by extrusion. *Center:* The strands are "bobbed" by girls to give them the right length. *Right:* Spaghetti on racks is placed in a drier

SALT MAKING

By C. F. STRICKLAND

1 Service

The Commissioner of Salt Revenue, Northern India, making inspection

Fresh water for drinking reaches the salt making area on camels

Transporting pan salt by means of pack animals, human and bovine

ONE of the most important industries in India is the production of salt. Every human being, every animal, and a number of industrial enterprises must consume salt in one form or another, and the total annual demand of that vast country, with 330,000,000 inhabitants and 300,000,000 farm or transport animals, is no less than 2,000,000 tons, at the rate of about 13 pounds per human head. One quarter of this amount is imported, chiefly from Egypt and Aden. Of the remaining 1,500,000 tons, two parts are produced in sea-salines on the shores of Bombay and Madras (a little also in Burma), while 500,000 tons are excavated from rock-salt mines in the low hills of the Punjab, or made by evaporation from lakes and pits in the deserts of Rajputana.

The largest Rajputana source, yielding an average of 250,000 tons annually, is the Sambhar Lake on the boundary of the Jaipur and Jodhpur States. Though fed by four seasonal torrents in the hot months of the year, and covering at its maximum an area of 90 square miles, the lake dries up rapidly on the cessation of the monsoon rains in September, and is frequently dry by March or April. The salt is of high quality, containing 98 percent of sodium chloride; the remaining elements are sulfates and carbonates of soda without magnesium. It is extracted from the brine which collects in the lake during the monsoon rains.

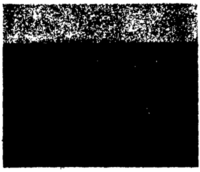
The primitive methods of manufacture were either the scooping of salt from the bed of sections, roughly enclosed in the lake itself with barriers of grass and stakes, or its collection from small pans in the mud at the edges. The former process is now obsolete, and the latter is dwindling from year to year. However, petty contractors still employ each a handful of laborers to bank up the pans, measuring 100 by 50 feet, and to extract the product. The salt is white and good, but of small crystals and inferior to that of the government evaporating plants. It is collected in small mounds and carried to an accessible and level spot on higher ground. Each laborer there again makes a mound of what he has collected. Its density and dampness are tested by weighing a sample from each mound, and the total weight is then estimated by means of an official rod laid on the sloping side of the pyramid. A tally is kept of each man's output and he receives daily payment. All the salt is then carried in headloads to a main heap, and becomes the property of the government.

The salt is usually allowed to settle and dry for a period of 12 months, after which this "pan-salt," lying at points somewhat remote from the railway sidings, is sold to *banjaras* (hawkers and peddlers), who arrive from all directions with carts, oxen, camels, and asses and carry it off to the outlying villages of the Indian States in Rajputana.

THE main output in these days is derived from the large *kyars* constructed by the British Government. A *kyar* is an embanked enclosure measuring sometimes as much as 4000 by 1500 feet, and including from 20 to 60 flat pans. The surrounding bank is high and pitched with stone, and the pans within it are divided by low ridges of mud, on which narrow pathways are laid for laborers. The floor is of lake-mud, but can be improved by a layer of sand on which cleaner salt crystals are formed. Brine is admitted from the lake at a density varying from 3 degrees by the Beaumé

An overseer measuring the mounds with a stick, as told in the article

Making big heaps out of little ones by a primitive "telpherage" system



The man seated in the foreground is keeping tally of the salt weights

IN INDIA

hydrometer after a light monsoon to 10 degrees after heavy rains. Its density is gradually raised within the pans by evaporation during the cold and rainless season from October onward, brine of lighter density being introduced from reservoirs to check the process if evaporation is too rapid to allow the steady and even deposit of salt crystals on the bottom of the pan.

The "accretion" system, which has been employed since 1923, results in a more orderly deposit than the older system of successive "crops," and has been rendered possible by the increased reserves of low-density brine in the recently added reservoirs. Each *kyar*, and if necessary each pan, can be matured at a chosen date throughout the cold season, and a more permanent force of laborers retained than was practicable on a method of "crops" which matured all the pans in a short period from March to May. Temporary labor is more expensive and less efficient; the scalding heat of the brine in the pans after midday during April and May also precludes a full day's work; it is therefore better to carry on the extraction regularly during the cold months, as can be done by accretion.

Salt crystallizes at 25 degrees to 29 degrees Beaumé; at the latter figure the laborers with their baskets enter the pan, scrape up the salt with shovels, and carry it away on their heads. The system formerly used required them to pile it in great heaps containing each about 2000 tons.

Payment at the rate of one pice (half a cent) for each load was made by an agent seated at the foot of the inclined path. A few such heaps are still built up beside the railway sidings which run into the *kyars*, though most of the salt is carried directly to a central storage place.

After settling and drying for a year, a heap is approved for issue, the salt is filled into bags, each of which is weighed, sewn up, and loaded in freight cars. Indents are handed in by merchants at Government Treasuries, and forwarded to Sambhar, where the salt officers select, bag, load, and despatch the salt. The cost of manufacture at 4 annas per maund (8 cents for 82 pounds) is recovered from the buyer, together with an excise duty at Rs.1/4/0 (44 cents), from which the Government of India receives an annual income of 25,000,000 dollars for all the salt of the country.

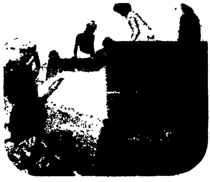
THE Sambhar works were reorganized and modernized in the years 1920-3 at a cost of 1,250,000 dollars. A dam two miles in length has been thrown across the end of the lake nearest to the salt works, converting the enclosed area into a reservoir of five square miles. The brine is pumped over the dam into this reservoir in the rainy season from the main part of the lake, and serves to supply the *kyars*. Permanent (meter-gage) or temporary (two-foot gage) sidings now run into the pans themselves, where the salt is directly loaded into trucks and hauled up a ramp to the top of a great open salt pile, the contents of which may at the fullest period amount to 200,000 tons.

To scientific manufacturers of salt the methods described may appear to be comparatively simple. It must, however, be remembered that India is a land with a low standard of living, which can bear only light taxation, and can not face the cost of an expensive installation. At all events the new method of recovering salt, as applied at Sambhar, represents a great advance on the primitive system of manual labor and scattered heaping, described earlier in the article, which has hitherto been in force.

Transport on donkeys. In India this form of "gasoline" is cheap

Spindle-legged laborers, men and women, extracting salt from a pan

A train of "trucks" discharging salt on top of a great central storage pile



Loading salt at the pans. It is dumped into "trucks" (gondolas)

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

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Lehigh University
MORRIS FISHBEIN, M.D.
Editor *Journal of the American Medical Association*, and of *Hygeia*

Large-Scale Insect Trapping

IN the summer of 1929 approximately 17,500 Japanese beetle traps baited with geraniol were used by the United States Department of Agriculture in lightly infested areas, and in 1930 the number was increased to 25,583. The department recommends trapping only where there is a light infestation. The baited traps attract beetles from a great distance and if used in heavily infested areas would draw abnormal numbers from neighboring properties to the property where the traps were used. The cost for bait and for operating the traps was $1.66 per trap in 1929 and $1.63 in 1930.

A new slot machine for dispensing cigarettes has been introduced in England. Five seconds after a penny is inserted, a lighted cigarette is delivered ready for the consumer

Synthetic Ham—What Next?

THE economic advantage of the cotton seed was stressed by David Wesson, technical director of the Southern Cotton Oil Company and vice-president of the Wesson Oil Company in a recent talk before the Rochester Section of the American Chemical Society. The title of his talk was, "Why the Cotton Seed?"

A new food product resembling ham in aroma and flavor was shown by the speaker and after his talk sandwiches prepared from it were served to the members of the audience. The new product is made by de-oiling cotton-seed meats, mixing the resultant material with vegetable shortening and water and then cooking it. The cost of the food, figured on its protein content, will be approximately five cents a pound, according to Dr. Wesson, as compared to a cost of between two dollars and $3.50 per pound of protein for meat products and 13 dollars per pound of protein when this material is consumed as lobsters. The product is in an experimental state at present but arrangements are under way to produce it in ton lots.—*A. E. B.*

Winter and Summer Sunshine

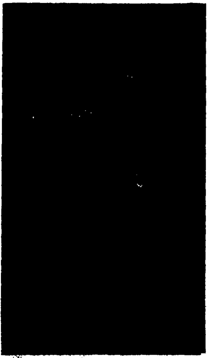
IN Toronto investigators found that a sharp increase in the ability of sunshine to prevent rickets occurred about the first of March. Colorado, the land of sunshine, has recently been subjected to a similar study by Drs. R. C. Lewis, G. M. Frumess, and H. B. Stein. They found that winter sunshine in Colorado contains a high concentration of biologically effective ultra-violet light and that there is no marked difference in the ability of winter and of summer sunshine in Colorado to prevent rickets. They feel that the reason why Colorado sunshine has such little seasonal variation is the fact that the relatively short-wave radiations reach that section throughout the year as a result of the high percentage of winter sunshine, the low humidity, and the small amount of smoke in the air.—*M. F.*

A New "Whirling Watcher"

A NEW type of stroboscope, a scientific device for "stopping" motion to study the behavior of machines operating at high speed, has been developed in the department of electrical engineering at the Massachusetts Institute of Technology.

The name stroboscope means "whirling watcher," and these instruments have long been used to study motion. The new type of stroboscope, which was developed at M. I. T. by Harold E. Edgerton, a member of the instructing and research staff, opens up a new field of research in that it permits "stop-motion" photography of moving machinery. Photographic exposures with the new instrument are made in a hundred-thousandth part of a second.

The unique feature of the new stroboscope is the electrical circuit which causes a condenser to discharge periodically through a thyratron mercury-arc tube. An intense blue actinic light of extremely short duration, precisely timed to correspond with the speed of the machine under observation, is produced by a large current through the tube, and makes it possible to adapt the stroboscope for photographic as well as visual observation. In the study of a synchronous motor, for example, the flashes occur as the north and south poles reach a given point in their whirling course. The thyratron is a tube that has been developed during recent years by the General Electric Company.



This photograph was taken with the aid of a new thyratron mercury-arc tube. The "N" and "S" on the poles of the 160-horsepower motor are moving past the camera at a ground speed of 95 miles per hour

NEW YORK LIFE INSURANCE CO.

51 MADISON AVENUE, NEW YORK CITY
(INCORPORATED UNDER THE LAWS OF THE STATE OF NEW YORK)
A MUTUAL ORGANIZATION, FOUNDED IN 1845

EIGHTY-SIXTH ANNUAL STATEMENT

To The Policy-Holders:

Most of us have labored together for a considerable period.

My service in Nylic has covered forty-two years. I have been President of New York Life Insurance Company for nearly twenty-four years.

In twenty-four years you have numerically been multiplied by three; and your collective property in this Company has been multiplied by three and a half.

You have made a great demonstration within a generation of the power that lies in co-operation between "humans." You have become increasingly convinced of two great truths.

First,— that "no man liveth to himself," and the less he tries to do that the more truly and fully he lives.

Second,—that men are naturally honest and that those in positions of responsibility and trust in business are more honest and much more capable than men are as a whole.

Emerging from the frightful financial disasters of 1930, people are wondering if it was all or in large part necessary. They a asking why such heart-breaking experiences should not naturally cease in countries organized to preserve the strength and the inspiration that lie in individual efforts and in the ownership of private property.

American life insurance reaches its present greatness just in time to answer that question. It is true that we have had in this the freest and most individualistic section of the world (United States and Canada) a disturbing experience. Could it have been avoided substantially? I answer it could and some day such happenings will be largely avoided.

New York Life Insurance Company
BALANCE SHEET—DEC. 31, 1930

First Mortgage Loans on Farms, Homes and Business Property	578,255,940.83
Bonds of the United States, Other Governments, States, Cities, Counties, Public , Railroads, etc	706,752,997.95
Preferred and Guaranteed	73,662,042.00
Policy Loans, Cash and Other Assets	396,089,181.03
Total Funds for Policy-holders' Protection	$1,789,067,734.00

LIABILITIES

meet all ntractual obligations	$1,588,057,722.02
idends payable to Pol-	72,541,788.00
	7,455,677.00
liabilities	$1,668,055,187.02
ral Contingency Fund	121,012,546.98
	$1,789,067,734.00

As we emerge from this setback in our economic system we discover that one thing remains unchanged and substantially unaffected.

It is almost literally true that every man who owns property is poorer today than he was a year ago; but to the extent that his possessions are represented by Life Insurance he is as rich today as he was a year ago. They (his Life and Endowment policies) have not shrunk in value—except as he may have used them as collateral to relieve his needs in other directions.

Suppose the total outstanding insurance a year ago had been 220 billions instead of half that—suppose the assets of the Companies had been 38 billions instead of half that. How much less would the speculation and loss have been in 1930?

Life Insurance Companies will ultimately achieve those totals and greater ones and they will yearly represent an increasing and conservative factor in the whole property problem.

Life Insurance assets are not used speculatively. With relation to our total national wealth those assets represent a steadily increasing factor. They increase the factor of stability and decrease the factor of chance. That gain has been steady for almost a quarter century. Outstanding insurance will double and assets will double long before the wealth of these countries doubles. The lesson of it all is that economic changes of profound significance and of fundamental importance are taking place as the result of the amazing growth of Life Insurance. Life Insurance does all that its devotees have claimed and now it emerges from this world catastrophe substantially untouched and rendering a public service that few people ever realize.

It was organized to mitigate the terrors of death. It has become a valiant and an increasing defense against the economic disasters that periodically devastate the business world.

In other words, we are, through Life Insurance, in these great, free countries, preserving individual enterprise and the rights of individual wealth and t the same time we re utilizing the almost asurable power of united and c

We are gaining on economic disaster and we shall go on gaining because Life Insurance will go on gaining.

In free countries there is no way to stop speculation; to do that arbitrarily would not be consistent with the principles of freedom. *But!* Yes, a great big *But!* When Life Insurance has become the great reservoir into which the people put their savings increasingly, speculation will become relatively less and we shall finally have adopted almost imperceptibly, a new economic program.

This will be founded on co-operation, brains and fidelity. That's a pretty good description of the elements that have made our Life Companies great—co-operation, brains, fidelity and, I add, hard work.

The balance-sheet above will show what a splendid part your Company is playing in the total.

DARWIN P. KINGSLEY, *President.*

DIVIDENDS Payable in 1931	NEW BUSINESS 1930	TOTAL RESOURCES Dec. 31, 1930	Insurance in Force Dec. 31, 1930
$72,542,000	$900,897,000	$1,789,000,000	$7,626,000,000

Branch Offices in most of the Larger Cities of the United States and Canada.

So powerful is the new stroboscope that still and motion pictures of a 160-horsepower motor have been made while the machine was running at full speed. Although the rotor was turning over at a rate corresponding to a ground speed of 95 miles an hour, every detail of the moving parts was shown as clearly as if the machine were standing still. Thus it was possible to study the characteristics of the machine from the moment the power was applied until it reached full speed.

Guanayes marching and countermarching with the, to them, curious tractor

The new stroboscope is being used chiefly to study rotating electrical machinery, but it can be employed to "stop motion" in almost any type of machinery, and will be useful for studying the behavior of cams, springs, valves, and other moving parts.

The instrument will be particularly valuable for the study of electrical machinery. It will make possible highly accurate studies of the angular displacement of motors, generators, condensers, and lines during switching or short-circuit disturbances. In the steel industry and in many other manufacturing processes, motors are often subjected to violent sudden load changes. The new stroboscope will make it possible to see and record photographically just what happens in the motor under such operating conditions.

Muscle Cramps

ONE of the most common complaints in recent years is muscle cramp, a form of pain which is closely related to the condition called "heat cramp." For example, athletes who perspire greatly and fail to get enough water into the body are likely to complain of cramps in the muscles of the thigh and the calf. Workers in extremely hot employment are likely to develop cramps which are related to somewhat the same cause. During hard muscular work, with or without high temperatures, when there is a great deal of perspiration, the kidneys are ordinarily out of action. In such case[illegible] an enormous output of nitrogen i[illegible]ine and retention of chlorides. A [illegible] salts are lost by free perspiring and a [illegible] water is taken into the body, there is a rise in the diffusion pressure with a prompt onset of cramps. Prolonged sweating increases the concentration of chlorides in the perspiration, and decreases the percentage of chlorides in the blood. The intake of water during a sweat increases the excretions of both water and minerals. It is suggested that the prevention and treatment of such conditions involve taking water to which a small amount of salt is added as, for example, a salt solution from 0.3 to 0.5 percent.—*M. F.*

Machine-Minded Sea Birds

THE guanaye, or Peruvian cormorant, inhabits the islands in the Humboldt current off the coast of Peru. These islands have for a century provided the world with the valuable fertilizer known as guano.

The guanaye is protected by law from any molestation and until a few months ago no motor vehicle or airplane was permitted on or near its habitation. Recently, however, Caterpillar tractors were introduced on San Martin and Santa Rosa islands to take the place of the old-fashioned system of mining the guano by hand, and the birds were carefully watched for signs of anxiety.

On the appearance of the tractors the guanayes immediately manifested the keenest interest and fell into solid military formations in front of and behind the machines, inspecting every detail of the work in progress with profound enthusiasm. Indeed they marched and countermarched in such numbers that the tractors were operated only with the greatest difficulty.—*The Grace Log.*

Radio Pillow Sings to Sleepy Ear

A SPONGE rubber pillow that sings and talks to an ear placed upon it is the [illegible]t product of a radio company of Camden, New Jersey. It is intended for use in hospitals. A radio unit within the pillow is connected to a central radio receiver. So quiet is this type of installation that only the patient with his head on the pillow can hear the radio program.—*Science Service.*

Radiator Fluid Doubles Machine Gun Firing Capacity

ARM[illegible] Aberdeen [illegible] Ground have doubled the firing capacity of machine guns by using ethylene glycol, a chemical employed to keep automobile radiators from freezing.

In experimenting, the officers substituted the fluid for water in the cooling mechanism of the guns and found that they could shoot twice as long as formerly. The fluid, it was discovered, ceased boiling almost as soon as the order to stop firing was given.

Water, it was said, continued to boil in the gun's jacket for some time after cessation of fire. They added that the loss by evaporation was almost twice as great with water as with the chemical.—*The New York Times.*

Sonic Altimeter for Fog Flying

AN instrument which would give a pilot indispensable aid in fog flying would be a height indicator or an altimeter independent of weather conditions—which the ordinary altimeter based on barometric principles is not. The General Electric

Photographs courtesy *The Grace Log*

The old method for harvesting guano for fertilizer. It is broken up by hand and packed in bags ready for shipment

With modern methods, the guano is broken up by means of tractors, thus replacing the method shown at the left

FURNITURE
KITCHEN CABINETS
OUTDOOR SIGNS
TRUNKS-TOYS
RADIO CABINETS
REFRIGERATORS
INCUBATORS
AND 80 OTHER USES

Industry daily finds new uses for this all-purpose board

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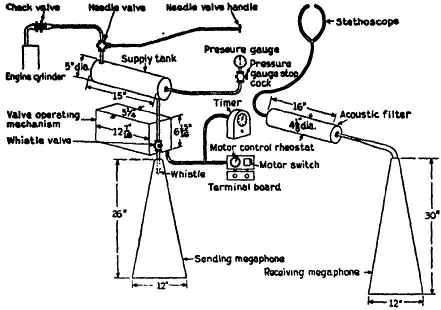


Diagram of the important parts of the new sonic altimeter

Company has now developed a sonic altimeter, which has been successfully tested by the Army Air Corps and which appears to meet this long felt want.

The sonic altimeter will give to the pilot the uncanny faculty the bat is said to possess—that of measuring distance from an object by the time which a sound takes to travel to and be reflected from the object. At least that is the time-honored explanation of the bat's ability to fly in pitch darkness and yet avoid all obstacles. The bat apparently emits a very high pitched note imperceptible to human ears.

The source of sound in the sonic altimeter is a specially designed high-frequency whistle, mounted in a megaphone which points down toward the earth. The air supply for the whistle is obtained by "bleeding" one of the engine cylinders through a check valve into a small storage tank. The supply of air required is so small that the functioning of the engine is not affected.

The receiving apparatus consists of a megaphone, also pointed downward, mounted in the tail of the airplane to receive the echo. This receiving megaphone is connected to the pilot's ears by a tube which terminates in an ordinary pair of stethoscope ear-pieces. An acoustic filter in the listening line reduces the engine noises.

The operation of the device is as follows: The pilot opens a needle valve which allows the check valve to pass air to the tank up to about 100 pounds pressure. At the same time he closes the switch which starts the motor-operated whistle valve. He also places the stethoscope ear-pieces in his ears. Each time the whistle valve sends out a blast a pointer on a timing point starts moving uniformly around its scale. The time taken to hear the echo is a direct measure of the height, and the scale on the timer is so arranged that the height is read directly.

We can imagine the pilot guided to a field by a radio beacon, informed of the boundaries of the airport by an electromagnetic signalling system, and making a safe landing by measurement of the height above the ground by use of the sonic altimeter, all in the densest fog. Altitudes of as low as 50 feet and as high as 1000 feet can be accurately determined by this instrument, which should certainly increase safety to a marked extent.—*A. K.*

International Aviation

IN the first chapter of his book, "International Control of Aviation," Professor Kenneth W. Colegrove summarizes in splendid fashion the problems of international aviation. One phase concerns the regulation of aircraft in the course of interstate journeys. The second includes the development of airlines and manufacture of aircraft by governments as a means of promoting their trade, colonial expansion, and national defense. A third phase concerns the regulation and limitation of aircraft as a weapon of war.

The first problem is a matter on which jurists and statesmen have long worked. Is the air free, or has a government absolute sovereignty of the air above its borders? What is the nationality of aircraft? Should it be registered under a flag? Should the nationality of the proprietor determine the nationality of the aircraft? What if the pilot is of different nationality than the proprietor? The movement toward international control is confronted with the problem of determining what questions properly belong to international regulation and what should be left to individual states.

Nationalistic rivalries, with the airplane as a new medium, is a subject to be pondered by statesmen and peoples. Should nations take on the burden of airlines, in themselves unremunerative, as a matter of national defense?

Finally what of limitation of military aircraft? Battleships may be scrapped, but will peace be furthered thereby, if powerful aircraft are built without limitation?

Professor Colegrove's splendid book gives much food for thought. Apparently not only the engineer and operator have thought seriously of aviation.—*A. K.*

The Focke-Wulf "Ente"

THE type of plane known as "Canard" in French, "Ente" in German ("duck" in the vernacular), is not new. Santos-Dumont tried a Canard way back in 1907, calling his craft thus because of its resemblance to a duck in flight, and in 1908 Voisin made experiments with a similar type. In the United States, our readers may recall the efforts of Lieutenant Fernic, who perished in an unfortunate flight with a machine of similar design. Focke, in Germany, however, seems to be carrying on experiments with this type of "tail-first" airplane with fresh determination and success.

There are several advantages which may perhaps be considered inherent in this type of plane.

First of all, the Canard type cannot readily nose over even in the worst landing, because the center of gravity is so far behind the nose of the machine and the small front wheel.

Secondly, it is very difficult for the Canard type to stall; that is, have its wing meet the wind at too large an angle. The auxiliary wing at the front is placed at a larger angle of incidence than the rear or main wing. If the airplane noses up too much, it is therefore the front wing which "stalls." When this happens, the nose of the machine loses lift, and therefore the craft as a whole noses down. Stalling is avoided and this means the prevention of

Courtesy General Electric Company

The actual mechanism that constitutes the sonic altimeter

A WARNING *to men who would like to be independent in the next five years*

YOU CAN tell a $30 a week man how to make $40 a week.

You can tell a $50 a week man how to make $75 a week.

But you can't tell a $5,000 man how to make $10,000. He's got to know.

Between $5,000 and $10,000 a year is where most men of talent stop.

Health, youth, good appearance, brains will carry a man far in business.

But you cannot draw forever on that bank account unless you put something else in. Somewhere between $5,000 and $10,000 a year you will stop dead.

Those who go on add something to their equipment at the same time they are drawing on it.

Profound changes are taking place in business—this year, this month, *now*. The man who sees in these changes his opportunity for independence and power is the man who will make his fortune in the next five years.

BUT this opportunity, like all great opportunities, is fraught with danger. Business today is new and complex. The old rules will no longer work.

A whole new set of problems is presented by production.

Foreign markets have become a vital issue. An entirely new conception of selling is replacing the old hit-or-miss way.

The man who would take advantage of opportunity today dare not grope. His experience is a dangerous guide. He has no time to figure out all the possibilities and pitfalls. He lacks contact with the big, constructive minds of business.

How can he seize the *opportunity* and escape the *dangers?*

FOR two years the Alexander Hamilton Institute has been laying the foundation of a new Course and Service for the leaders of tomorrow.

The ablest business minds—the men who have had most to do in shaping present-day tendencies—have contributed greatly. Read the names of just a few of them:

ALFRED P. SLOAN, JR., *President*, General Motors Corporation.

WILLIAM F. MERRILL, *President*, Remington Rand, Inc.

HON. WILL H. HAYS, *President*, Motion Picture Producers and Distributors of America, Inc.; formerly U. S. Postmaster General.

BRUCE BARTON, *Chairman of the Board*, Batten, Barton, Durstine & Osborn, Inc., Advertising Agents.

JOHN T. MADDEN, *Dean*, School of Commerce, Accounts and Finance, New York University.

DR. JULIUS KLEIN, *The Assistant Secretary*, U. S. Department of C

FREDERICK H. ECKER, *President*, Metropolitan Life Insurance Company.

HUBERT T. PARSON, *President*, F. W. Woolworth Company.

DAVID SARNOFF, *President*, Radio Corporation of America.

COLBY M. CHESTER, JR., *President*, General Foods Corporation.

Men who are satisfied with $5,000 a year *will not be interested in this Announcement*

Men who are satisfied with departmental jobs and small earnings will not be interested in this type of training. It is offered to the kind of men who want to become officers of their companies or go into business for themselves.

Representing the condensed experience of the best business brains in the country, it offers real help to executives in meeting the difficult business conditions of today.

A BOOKLET has been prepared which tells about this new Course and Service. Its title is "What an Executive Should Know." It should be read by every man who faces the responsibility of shaping his own future. It is free.

We will send you this booklet if you will simply give us your name and address on the coupon below. But we do not urge you to send for it. If you are the type of man for whom the new Course and Service has been constructed, if you are determined to take advantage of the rich opportunities of the next five years, you will send for it without urging.

* * *

To the Alexander Hamilton Institute, 489 Astor Place, New York City. (In Canada, address Alexander Hamilton Institute, Ltd., C. P. R. Building, Toronto.)

Send me "What an Executive Should Know," which I may keep without charge.

NAME ____________________

____

BUSINESS ADDRESS ____________________

____

the dreaded, and very often fatal, spin.

Third, the occupants of the craft have a certain protection in the fact that the nose of the machine is so far from their compartment. Even if the machine crashes head on into the ground, most of the length of the fuselage acts as a shock absorber.

The mounting of two engines out on the wings is another measure of safety. Even if the engines let go, on a crash landing, they are not likely to injure the occupants.

The latest Ente is illustrated in our three photographs. It is powered with two Siemens Sh-14 engines of 110 horsepower each and its specifications are: Length over-all, 34 feet 6 inches; wing span, main wing, 32 feet 10 inches; wing span, forward wing, 16 feet 5 inches; area of main wing, 317 square feet; area of forward wing, 64.6 square feet; weight empty, 2585 pounds; disposable load, 1045 pounds; gross weight, 3630 pounds; maximum speed, 88 miles per hour; cruising speed, 80 miles per hour; landing speed, 52 miles per hour; climb to 3280 feet in 8.3 minutes.

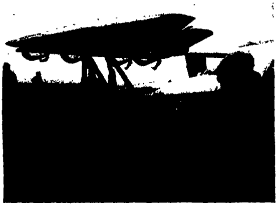
These performances are not high, but then the Ente is quite heavily loaded in proportion to its power. Also there is a source of inefficiency in the fact that there is an auxiliary wing ahead to disturb the air flow over the main wing.

In its structure the Ente follows more or less conventional lines. Immediately in front of the leading edge of the main wing begins the three-place passenger cabin entered by a door on the right side. In front of the passenger cabin the top of the fuselage sweeps down to the pilot's cockpit. The fuselage ends in a blunt point above which it supports the front wing on a series of struts.

The forward wing is trapezoidal in shape. Its trailing edges are recessed for the elevators. These are balanced and supported by a number of brackets, so that a slot is formed between the fixed auxiliary wing and the elevators. The slot becomes narrower when the elevators are depressed for climbing, and larger when they are raised for nosing down.

Because the center of gravity of the machine lies so far back, the vertical fin has to be made of enormous proportions, so as to equal the effectiveness of a moderate fin on the conventional airplane, placed far back of the center of gravity. To the large fin is attached a large narrow rudder. Even with these large vertical surfaces some difficulty appears to have been met in keeping the plane on a straight course. That is why two relatively large fin surfaces have been placed outboard under the wings, at a point between the engine nacelles and the wing tip. These wing fins are toed-in, perhaps to help counteract the offset torque, if one of the two wing-mounted engines fails.

Above: **Focke and his pilot Edzard in front of the Ente. This view shows plainly the auxiliary surfaces placed at the extreme nose of the fuselage.** ***Right:*** **The forward auxiliary wing, showing mounting, elevator, and slot**



This original design gives a certain amount of promise and results of experiments with it will be carefully followed in the United States.—*A. K.*

Overseas Travel Greater in 1930

MORE Americans traveled abroad in 1930 via the Port of New York than ever before. For 12 months up to the end of November 1930, a total of 673,445 United States citizens passed in or out of Sandy Hook, an increase of 27,553 over the same period ending November 1929. Also during the same period, 34,296 more non-emigrant aliens departed than in the previous year.

These increased movements more than offset the drop in the number of inbound aliens bound for these shores, and which has been brought about by a downward revision in national quotas and stricter supervision of admittances.

New Line of Scale Model Airplanes

THE new line of model airplanes shortly to be introduced by the Selley Manufacturing Company, Inc., of Brooklyn, New York, with the approval and co-operation of the Curtiss-Wright Flying Service, is expected to establish a new vogue among the model enthusiasts of the country. The models are scale-reduction, non-flying models of the more popular Curtiss-Wright ships. They will be sold in complete construction sets through the Curtiss-Wright distribution facilities and will also be available to toy dealers throughout the country.

The kits will be packed in a modern and attractive cardboard box, sealed by the manufacturer to prevent loss of any of the parts. They will be known as the "Official Curtiss-Wright Models" and will be marketed partly under the supervision of the Curtiss-Wright Flying Service, Model Division, 27 West 57th Street, New York City.

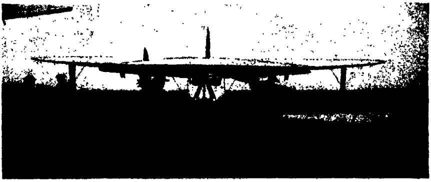
The first three models will be the Curtiss Hawk Pursuit plane, the Curtiss Condor transport plane, and the Travel Air Mystery S racing type plane.

While these models are non-flying, scale reproductions, the plans are accurate enough for an expert model builder to make them into flying models.

A New Compass

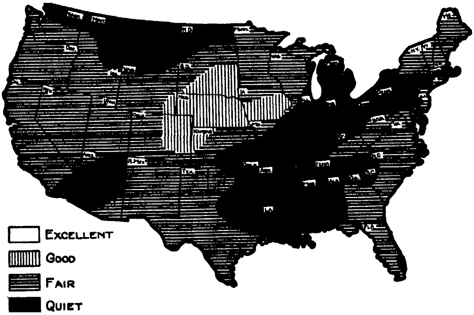
AIRCRAFT flights are constantly increasing in duration and distance and require a correspondingly greater amount of navigation over unfamiliar territory and through fog and darkness. The compass therefore becomes more than ever an instrument of great importance.

In a new compass, termed the Pioneer Straightway Compass, made by the Pioneer Instrument Company, everything has been done to reduce period and overswing.



The front view of the Ente shows the abnormally wide landing gear, with struts running directly to the engine nacelles. Note the vertical fins near wing tips

The HOW, the WHERE, and the WHEN of Profitable Business



AFTER the right product has been made at the right price, the HOW of selling it profitably lies in determining the WHERE and the WHEN of the market.

The WHERE of profitable business is only partially geographical. A research of the U. S. Department of Commerce shows that 237 counties in the country, only 8% of the total, do 81% of all industrial purchasing. Another research of the U. S. Department of Commerce shows that 10% of all manufacturing establishments in the country do 78% of all business and employ 70% of all workers.

Thus, concentration in areas where purchasing power is greatest and further concentration among the larger establishments in these areas constitute the WHERE of profitable business.

The WHEN of profitable business is both actual and psychological. The FORBES Map of Business Conditions shows where business is *actually* good. The WHEN of profitable business is determined also by the mental attitude of managing executives.

Readers of FORBES are given not only the facts of business but forecasts of economic, sociological, and financial trends as they affect the future. And, in addition to supplying facts and forecasts, FORBES is edited with the intent to rouse men to action. The reading of FORBES impels executives to conquer circumstance and carry out aggressive and intelligent business development programs. The editorial pages of FORBES determine the actual and psychological WHEN of profitable business.

For an economical and effective advertising program to sell products to commerce and industry, the advertising pages of FORBES are the HOW, the WHERE, and the WHEN of profitable business. Here is a market concentrated among those who decide on purchases in large-volume concerns in preferred buying areas.

Send for facts on the HOW, the WHERE, and the WHEN of profitable business as indicated by the research of the U. S. Department of Commerce correlated with facts on FORBES circulation. Check the list for the exhibits you want.

A. Dept. of Commerce survey of preferred U. S. purchasing areas and FORBES circulation count in those areas.

B. Summary of Dept. of Commerce survey of concentration of manufacturing among large-volume concerns and representative list of concerns rated over $1,000,000 subscribing to FORBES.

C. Reprint of FORBES Map of Business Conditions for past twelve months.

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To do this, the weight of the magnetic element has been reduced to a minimum, the damping factor has been increased, and yet the magnetic control has been made particularly strong.

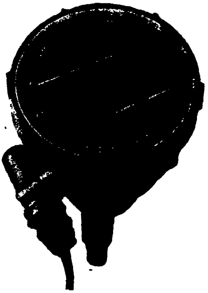
The indicating element differs from the conventional magnetic type in that the circular compass card has been eliminated to reduce weight and surface friction. It is now replaced by a spider which carries two broad parallel bars, treated with luminous material. The spider also supports magnets made of special cobalt steel of great magnetic retentivity. An accurately hardened and lapped steel pivot is placed above the center of gravity of the magnetic system. When the point of the pivot rests in the sapphire cup jewel, the spider is perfectly balanced, and the luminous lines and the magnets are horizontal. Great care is taken in the manufacture and assembly of the pivots and sapphire cups so that friction is practically eliminated.

The magnetic element is contained in a cylindrical bowl which is filled with a water-clear mineral spirit. This liquid serves to damp the motion of the magnetic element against oscillation while allowing it to remain sensitive to changes in direction. The bowl is fitted with a rotatable glass covered ring which can be locked into position by a thumb-lever on the side of the compass. A circular card with the cardinal points indicated by letters and the intermediate points by numerals is permanently fixed under the glass cover and rotates with it. Two parallel lines, which are coated with luminous paint, and are of the same width as the lines on the magnetic element, cross the center of the circular card in a north-south direction as shown in the illustration.

To steer a course, the top of the compass is turned until the desired heading coincides with the lubber-line, which coincides with the axis of the airplane. The top ring is then locked into place by a thumb-lever, and the plane is steered until the two lines across the glass face are parallel with the two lines on the magnetic element. The ship is then on the desired heading.

By using the parallel-line method of indication, the possibility of errors in reading is eliminated. The conventional magnetic compass must be observed from a position directly in front of the instrument, otherwise an error known as "parallax" is made. Therefore, the parallel lines greatly simplify steering. The permanent setting relieves the pilot of remembering his heading.

Such a compass must not leak when the altitude changes as much as 30,000 feet, and neither 122 degrees above nor 30 degrees below zero, Fahrenheit, must cause it to leak or freeze.—*A. K.*



New Straightway compass, showing parallel lines mentioned in text

Fastest on Land

ON Daytona Beach, Florida, Captain Malcolm Campbell on February 4 raced his specially-built *Bluebird* along the sands at the tremendous rate of 245.733 miles an hour. Before passing the measured mile of the course, he had taken a flying start of 5⅛ miles. His achievement puts him far ahead of the previous world record for land vehicles which was held by the late Sir Henry Segrave, also an Englishman, whose speed was 231.3 miles an hour.

The accompanying illustration, reproduced through the courtesy of *The Autocar*, British motor magazine, shows details of construction of the new record holder, the *Bluebird*. It is driven by a 12-cylinder Napier-Lion aviation engine, the rating of which is said to be 1450 horsepower. The body and wheels are carefully streamlined and a large tail fin, similar to a rudder except that it is rigid, acts as a stabilizer to make straight-forward steering easier at high speeds.

It will be noted from the illustration that the radiator is not a part of the streamlined body but sits forward so that air passing through it is ejected along the outside of the hood. This design was adopted to prevent interference that would be caused by the increased wind resistance if the air were allowed to fill the inside of the body and emerge into the "cockpit" or other outlets toward the rear. Cooling water enters the radiator through one upper tube and returns through two others.

In order that the driver might sit as low as possible and thus give greater stability to the car, the drive is geared and offset to one side. This feature is shown in one of the drawings. Other details are more or less self-explanatory but the jack housing is unusual. This consists of a casting, bolted to the spring, through the tubular part of which a special screw jack is inserted when it is necessary to change wheels or tires. This was deemed necessary because of the great weight of the front end of the car.

The Biologic Detective

DETAILED studies of the reactions of the human body under various conditions have caused the development of a new science which may very well be called biologic detection. Already it has been shown that ultra-violet rays bring about fluorescent appearances which serve the purpose of detection. Thus a strand of hair found near the body of a dead individual might have belonged to any one of three people who had hair similar in appearance to that which constituted the evi-

Sectional view of Campbell's *Bluebird* and, lower left, top view showing off-set fin and drive shaft dence. The application of ultra-violet light to the hair under suspicion revealed a purplish luminosity which was visible in the hair of only one of the three people under suspicion. It was found that the luminosity of the hair was due to the large quantities of aspirin which had been taken by and excreted in the hair of the individual concerned.

The biologic detective uses the X ray and ultra-violet rays for finding concealed things. He uses chemistry to determine the amount of alcohol in the circulating blood. He has investigative methods which show not only the age of blood stains but also the species from which the blood happens to have come. He has tests indicating possible paternity of a child, and by use of finger prints he obtains evidence of the greatest value in determining human relationship and in identifying suspected characters. The application of the microscope, the biologic precipitation tests, ultra-violet and spectroscope studies, and similar methods, are now a part of the regular practice of the biologic detective.

Big Gain for "Lucky Strike"

THE excellent showing of the American Tobacco Company is due in large measure to the success of its advertising campaign on "Lucky Strike" cigarettes. Sales of this brand in 1930 showed an increase of about 6,000,000,000 over 1929, while the cigarette industry of the country as a whole lost slightly. Other products, however, are also profitable, with half a dozen or more of American's lesser brands contributing as much as 250,000 dollars annually to earnings; though "Lucky Strike" cigarettes and "Cremo" cigars, the two brands to which practically all of the advertising is devoted, are the only ones showing large sales gains.

There has been no recent change in the trend of American Tobacco's operations, so that a further increase for 1931 seems reasonable. In this case, payment of an extra dividend before the end of the year might well be looked for, American Tobacco having followed for some time a policy of declaring extra dividends generously. Of course, American Tobacco's growing business necessitates the retaining of a substantial part of earnings to add to manufacturing facilities and to inventory, which is bought three years ahead. Both of these items will show increases in the December, 1930 balance sheet over the figures of the year before.—*Barron's.*

Addison's Disease

ADDISON'S disease is not a common condition. It is usually the result of some pathologic change involving the adrenal glands. In the past, patients with this disease have gone progressively downward, although having occasional remissions, but death ensued almost invariably after a fairly brief period. Heretofore, the treatment has merely included rest, warmth, relaxation, and good hygiene, with an attempt to supply in some manner the deficient substance, although until recently no active extract of the cortex of the adrenal was available.

During the last five years, investigators in various clinics have been attempting to isolate the active substance exactly as ac-

IRON FIREMAN
CREATES
Prosperity
THROUGH
ECONOMY

users saving more than
$5,000,000 A YEAR

IRON FIREMAN cuts fuel bills . . . provides steady, automatic heat . . . prevents smoke . . . saves labor.

Success in your business, or economy in your home—each hangs on a single thread: *Keep your costs below your income.*

A recent survey shows that, in business installations, Iron Fireman savings represent average earnings of 39.4 per cent per year through fuel savings alone. In residences, the survey showed average savings of $90 a year on fuel alone. Iron Fireman users will save more than $5,000,000 in 1931. *Will you get your share of these savings?*

Let Iron Fireman Help Pay for Itself

Iron Fireman can be purchased on the time payment plan. Fuel savings and other economies of operation will go far toward meeting your monthly payments.

Write for illustrated literature, or ask your Iron Fireman dealer to send an engineer to examine your heating plant or boiler and estimate your possible savings. Use the coupon. Iron Fireman Mfg. Co., Portland, Ore. Branches or subsidiaries in Cleveland, Chicago, St. Louis, New York, Milwaukee. Dealers everywhere.

State-Planters Bank Building, Richmond, Virginia—"Iron Fireman has cut our fuel bill in half. There is also saving in labor as the machine is fully automatic, affording more uniform heat and constant boiler pressure."

IRON FIREMAN
Automatic Coal Burner
THE MACHINE THAT MADE COAL AN AUTOMATIC FUEL

Pyrex pipes running through the office of a chemical plant enable an executive to keep a constant check on the color and so on of liquid flowing through them

tive substances have been isolated from the pancreas, the thyroid, the pituitary, and the liver. Apparently the long-sought substance has now been made available, since Drs. Swingle and Pfiffner of Princeton University and Dr. Hartman of the University of Buffalo have secured a substance which will prolong indefinitely the lives of animals from which the adrenal glands have been removed. Moreover, in e large clinic in the United States, seven [illegible] dy with apparently excellent results. They recovered their appetites, gained in weight, and felt much better.

Here is another example of what can be accomplished in scientific medicine by logical scientific experimentation. It must be pointed out that in this case, as well as in the discovery of insulin, dogs have been used. The result has been the possibility of longer and useful lives for human beings who previously would invariably have died.—*M. F.*

Chemical Glassware Invades the Plant

THANKS to recent advances in the technology of glass manufacture, the familiar laboratory glassware of the chemist is now available for the large scale operations of the factory. Glass pipe lines of Pyrex are being used for handling many liquids because such pipe does not corrode, is heat resistant, and permits constant visual inspection of rate of flow, color, and consistency. Pyrex fittings permit the same flexibility of layout as metal pipe and fittings. Installation requires no specialized skill—no tool other than a wrench. Cast aluminum split flanges fit over the pipe ends and a [illegible] other suitable material is used between the flange faces.

The photograph shows a section of glass pipe in a modern chemical plant where it runs through the office of an executive who is thus able to see the condition and rate of flow of the liquid by merely glancing up from his desk.—*A. E. B.*

Laboratory on Wheels Tests Milk

TAKING the milk testing laboratory to the milk sample, instead of the milk sample to the laboratory is a new procedure recently started by the New York State Department of Health, of which Dr. Thomas Parran, Jr., is commissioner. Two laboratories on wheels have just been put into operation by the New York State Department of Health to provide facilities for accurate examination of milk samples anywhere in the state. The laboratories will be used in the milk-supply study authorized by the last legislative session to bring about more effective sanitary control.

Passenger buses were adapted for the purpose by removing the usual seats to provide a space of 7 by 18 feet for equipment, according to a description in *Health News*. Laboratory benches are installed along the sides and across the back of each bus, and a sink with hot and cold running water is provided, a small water storage tank under air pressure, which may be filled from outside the bus, serving as a source.

Most of the equipment is electrical; there are an electric water heater, incubator, refrigerator, autoclave, sterilizing oven, unit heater, fans, lights, and the like. Although the incubator is operated by storage batteries, most of this equipment makes use of an electric meter fitted with long lead-in wires to connect the bus to a 110-volt power circuit when the bus is standing at a milk station or plant. A Babcock tester for butter fat determinations, as well as microscopes and other equipment for bacteriological examination of samples, is included in the equipment.

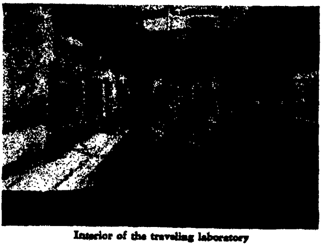
In addition to determination of the sanitary qualities of the larger milk supplies throughout the state, the two traveling laboratories will make possible more or less pioneer work in some of the strictly rural communities, the report states.—*A. E. B.*

New Evil-Scented Denaturant not Deadly

DENATURING of industrial alcohol—not by poisonous wood alcohol, but by a new substance which smells like everything evil, which cannot be removed by bootleggers and which will not kill even if taken internally was begun on January 1. Alcotate, as the new denaturant is called, will be substituted for methanol in all completely denatured alcohol formulas, according to an announcement by Dr. J. M. Doran, Commissioner of Industrial Alcohol. Elimination of methanol in specially denatured formulas also is contemplated, but such action will require further consideration before it is made effective.

The Commissioner's decision to abandon the use of the poisonous denaturant had been anticipated for some time, as chemists of the Bureau of Industrial Alcohol had

Traveling milk laboratory used in New York State



Interior of the traveling laboratory

been working on the development of a non-poisonous but bootleg-proof denaturant for the past three years. Action by Commissioner Doran probably was hastened by renewed agitation in Congress this session against continued use of toxic denaturants.

Alcotate is a derivative obtained from California petroleum in the cracking process and is extremely obnoxious both in odor and taste. Commissioner Doran is convinced that the new denaturant cannot be removed from industrial alcohol by any chemical process, thus preventing the use of alcohol so denatured as a beverage. It has been subjected by the Bureau's laboratory to all known "bootleg" treatments, such as filtering through carbon and fractional distillation in column stills.

Courtesy General Electric Company

This new 50,000-watt lamp with a 1,500,000 lumen output delivers light equivalent in amount to that used in 50 average homes. Its 3-pound filament contains sufficient wire to make 125,695 twenty-five-watt Mazda bulbs. This lamp is for use in taking talking pictures

The present completely denatured formulas to which, said Dr. Doran, an increasing number of fatalities has been attributed, contain 4 percent of natural wood alcohol and 0.75 percent of aldehol. The new formulas will substitute for the wood alcohol 1 precent of alcotate and increase the aldehol content to 1 percent.—*A. E. B.*

Unsuspected Heart Disease

IN Cincinnati, the Heart Council recently investigated 1000 white men working in machine and hand tool shops as to the presence of physical defects that had not previously been found. Many men employees over 40 years of age refused to be examined for fear the examination might result in loss of employment. Previous to examining the mechanics, 1000 clerks had been carefully studied.

As an indication of the importance of early infections on the heart in later years, 21.9 percent of those who had lesions of the heart had had some of the common infectious diseases and 31 percent of all of the men examined had signs pointing to various irregularities in the heart. Almost one half of all of those who were

(Please turn to page 277)

EXTRA! EXTRA! EXTRA!

"Atlantic Flyer Saved at Sea — Night of Suspense is Broken." "Son Rescues Mother from Flames." "Goat Wanders Into Hospital." Adventure . . . drama . . . comedy . . . *news!* News flashed from every corner of the world — spun into print by whirling presses long before dawn streaks the eastern sky.

"Extra! Extra! Extra!" the newsboys cry, "All about de big moider-r-r!" And while they shrill their wares in the wan, bleak hours of early morning, deft fingers slip the "extra" under the door of your Statler room.

This "extra" service gives you the news of the day the minute you crawl out of your soft, warm bed . . . tells you of those events that bear directly on your business . . . contacts you with the world at large even before you've had your morning orange juice.

Our guests appreciate this Statler "extra"— and many of them tell us it's one of the reasons they use our hotels. And whenever we hear these friendly comments, we dedicate ourselves anew to the privilege of making them comfortable.

You have told us that you like the radio and private bath and circulating ice water with every room — and the courteous service of our Statler-trained employees. And we assure you that the hotels which first provided you with these and other "extra" comforts, are always finding new and pleasant ways to make your stay with us enjoyable.

A newspaper is slipped under your door every morning. It is one of the Statler "extras" for which no charge is made.

HOTELS STATLER

BOSTON BUFFALO

in NEW YORK, *Hotel Pennsylvania*

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

IT is now five years since the hobby of amateur telescope making was placed before our readers and nearly every issue of the magazine since then has contained in one place or another the description of some activity or other of the amateur worker. We receive numerous inquiries from readers who apparently have noticed this department for the first time and who either regard it as an isolated account or suspect it of being a department which may have appeared possibly as many as two or three times before. But matter on amateur's telescopes has appeared in about 60 back numbers of the SCIENTIFIC AMERICAN.

Harold A. Lower's clepsydra telescope drive

THIS month, instead of the usual description of telescopes made by the amateur from the instructions in the SCIENTIFIC AMERICAN book "Amateur Telescope Making," we present a few "accessories" and some odds and ends of the art. One amateur who seems to be everlastingly at it is Harold A. Lower of San Diego, California (1032 Pennsylvania Avenue). We have published photographs sent by Lower on one or two previous occasions and now we show one of his water-clock drive; also one of a flat he has made. Lower writes: "The picture shows about all there is of the clepsydra or water-clock. Everything is made of brass except the piston, which is aluminum. The inside of the brass cylinder was highly polished and the piston very closely fitted. There is so little friction that the piston will move of its own weight. The cylinder is mounted horizontally so that the changing weight of water will not affect the rate. The apparatus works much better than we expected. No tremors due to the drive can be detected, even with a high-power eyepiece. The motion is smooth and steady."

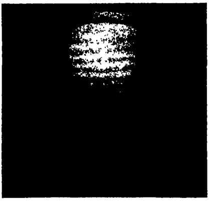
The principle of the clepsydra is simply water escaping through a minute opening. This allows a piston gradually to move and the piston rod actuates the telescope tube through some mechanical connection; in the present case by a length of picture wire. It is said that one must be fussy with details in order to make one of these things work accurately and smoothly. In fact, that is just what we had advised Lower before he made it, but it didn't stop him and he "proved the pudding." Later he sent us a word of warning based on the experience he gained: "First," he says, "there should be a screen to prevent dirt in the water from getting into the needle valve which lets the water out. Secondly, the needle valve requires a fine control; an old radio vernier dial works fine." The cylinder is usually placed on the north but Mr. Lower moved it to the east side, as shown, in order to photograph it.

Lower sends in a detailed criticism of his own flat; it is only a maiden effort, he says. The edge is turned (they usually are) but he expected that and purposely began with a larger disk (12 inches) than the flat he needed. Just inside the edge there is a raised zone of half a fringe (less than 1/200,000 of an inch). The irregularities near the center will be in the shadow of the secondary used in testing a Cassegrainian. The photograph was taken by blue light, hence the inaccuracies show up more than yellow sodium light, with its greater wavelength, would reveal. The photograph does not do the flat full justice.

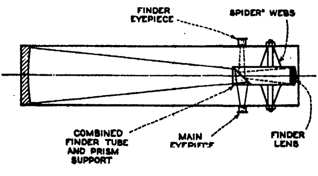
OPPOSITE is an observatory by G. F. Hofferberth (Rural Route 13, Dayton, Ohio). Hofferberth was one of the earliest telescope makers. He says: "Boy, that curved dome was some job [told you so]. Every time I wanted to add a piece of roofing it had to be cut curved, but the dome sure is a daisy. The dome framing is of wood and the shingles of Compo pitched down with steep roof pitch. The dome is 86 inches in diameter." Hofferberth, in an unguarded moment, has confessed that he built the dome in a barn and then had to tear off the side of the barn in order to get the dome out.

FROM Pittsburgh comes the following, signed by Leo J. Scanlon, Sec.-Treas. of the Astronomical Section of the Academy of Science and Art of Pittsburgh (1405 East Street, N. S. Pittsburgh, Pa.). "Here is a brainstorm I had recently for getting the most out of a prism or flat, when it is desired to use a finder on a telescope. When a prism is used you simply silver the back of it and use the silver surface for a flat mirror in the optical train of the finder; when a flat is used you silver both surfaces of the flat." See Scanlon's sketch.

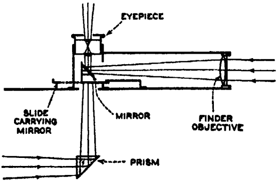
BELOW is another which is no more of a "brainstorm" than the first—on the contrary, pretty good, we think. The writer



Fringes on Mr. Lower's flat



Leo J. Scanlon plays both ends against the middle



E. Lloyd McCarthy's invention, described in the text

is E. Lloyd McCarthy of Canton, New York (10 Powers Street). "In brief," he says, "the idea is to use one eyepiece for the finder and speculum also. When the slide carrying the small 45° *mirror is pulled out* the mirror delivers light from the finder to the eyepiece. When the object is in the center of the field the slide is pushed in, allowing the light from the speculum to pass through a hole in the slide and thence to the same eyepiece." Can you beat it?

IT appears that each and every amateur worker must have obtained a copy of the Bureau of Standards' Letter-circular 32, on Silvering, as the Bureau has repeatedly been forced to prepare new editions. This rough, mimeographed publication has now been replaced by Circular 389 of the Bureau, entitled "The Making of Mirrors by the Deposition of Metal on Glass." This is a printed pamphlet and a valuable source of practical information. It is no longer to be obtained from the Bureau but from the Superintendent of Documents, Government Printing Office, Washington, D. C., the price being five cents and, by the way, the Government will not accept payment in postage stamps.

Hofferberth's observatory

In this new circular on silvering the Bureau, at which quite a lot of silvering is regularly done, lays new stress on the risk involved in silvering by the Brashear process. One is taking an entirely unnecessary risk, they state, "probably greater than is commonly realized," in silvering without goggles. We never have received word of a single explosion due to silvering, though several thousand have silvered. Can anyone tell us of a concrete instance? On general principles it is, of course, better to be careful than sorry and we have no motive for minimizing the risk or pooh-poohing it.

The same circular states that the reducing solution does not deteriorate with age. This statement has appeared many times and probably is correct. On the other hand we recall seeing in one or perhaps several rather recent periodicals or books the statement that reducing solution improves with age, up to a certain period, and then a deterioration sets in. Can anyone advise us where such statements have appeared? We have lost the reference.

Apparently the Bureau has upset the claim that the Brashear process of silvering gives a coat that reflects more light than the others. However, as our space is used up, let the worker obtain the circular and read about it.

INVENTIONS AND PATENTS
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CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Algebraic Charts, By Edgar Dehn. Six graphic charts for quick approximate solutions of quadratic cubic and biquadratic equations, for engineers and others. *Columbia Press, 509 Fifth Ave., New York City.—$1.00.*

Embrittlement of Boilers (Bulletin No. 216, Engineering Experiment Station, University of Illinois) by Frederick G. Straub is a report of an investigation conducted by the Engineering Experiment Station in co-operation with the Utilities Research Commission. *Engineering Experiment Station, University of Illinois, Urbana, Ill.—65 cents.*

Timber Growing and Logging and Turpentining Practices in the Southern Pine Region. (Technical Bulletin No. 204, United States Department of Agriculture) by R. D. Forbes, gives the measures necessary to keep forest land productive and to produce full timber crops. *Superintendent of Documents, Washington, D. C.—30 cents (money order).*

Burning Pulverized Iowa Coal (Bulletin 97, Engineering Experiment Station, Iowa State College, Ames, Iowa) by Earl B. Smith, is a critical study of Iowa coal. *Engineering Experiment Station, Iowa State College, Ames, Iowa.—Gratis.*

The Co-ordination of Light and Music by A. L. Powell, describes the latest development in this comparatively new field of electrical endeavor. *General Electric Company, Nela Park, Cleveland, Ohio.—Gratis.*

War and Inventions (Reprinted from American Journal of Sociology, Vol. XXXVI. No. 4, January 1931) by Joseph Rossman, Ph.D., is a careful study which shows that war is a powerful stimulus to invention of war implements. The author, who is a patent examiner in the United States Patent Office, says that basic war inventions have been made chiefly by civilians. A military environment is not conducive to invention. *Address Dr. Joseph Rossman, U. S. Patent Office, Washington, D. C.—Gratis.*

The Effect of Furnace Gases on the Quality of Enamels for Sheet Steel (Bulletin No. 214, Engineering Experiment Station, University of Illinois) by Andrew I. Andrews and Emanuel A. Hertzell reports an investigation conducted by the Engineering Experiment Station in co-operation with the Utilities Research Commission. *Engineering Experiment Station, University of Illinois, Urbana, Ill.—20 cents.*

TO make this page of greater value to our readers, the editor shall be glad t
review papers and bulletins on any phase of science, engineering, or industry. However, we do not wish ordinary catalogs, and
what is obviously propaganda.

Material submitted should give full information as to where obtainable and the price, if any, so that the reader may obtain copies directly without unnecessary correspondence. — *The Editor*.

The New Way of Designing and Building Gas Lines with Smithwelded Pipe (Bulletin No. 510) will be particularly illuminating and helpful to those who wish to arrive quickly at pipe line costs for various combinations of pressure, volume, and dimensions. *A. O. Smith Corporation, Milwaukee, Wis.—Gratis.*

Electric Arc Welding presents such facts about the electric arc welding process as are essential to its successful application to practical work. 80 pages, Fabrikoid binding. *The Hobart Brothers Co., Troy, Ohio.—$1.00 postpaid.*

The Economic Production of Workingmen's Homes by Grosvenor Atterbury, gives an outline of a scientific solution of the housing problem and its relation to the development of the City of New York. The houses are factory built. The experiences of the Sage Foundation at Forest Hills are given. *Grosvenor Atterbury, 139 East 53rd Street, New York City.—Gratis.*

The Radio Decade describes the progress that has been made in the art of radio communication from 1920 to 1930. It deals in main with commercial services, but touches lightly on broadcasting and the entertainment angle of radio. A double-page map giving a comparison of international communication services in 1920 and 1930 is especially interesting. *Radio Corporation of America, N. Y. C.—Gratis.*

One Thousand Useful Books, compiled by the Detroit Public Library for the American Library Association, was published originally in 1924 and has filled a very useful niche. The classification is excellent, the titles are well chosen and prices are given. The needs of small libraries as well as those of individuals have been carefully considered. *American Library Association, Chicago, Ill.—75 cents.*

gives full in-
o both their straightway and skyway compasses. *Pioneer Ins*
754 Lexington Ave., Brooklyn, N. Y.—Gra

Cow Testing Associations in Iowa (Extension Service Bulletin No. 99, Iowa State College of Agriculture and Mechanic Arts) by C. L. Blackman, A. C. McCandlish, and H. R. Searles. The cow testing association is an organization of farmers for co-operation in the improvement of their dairy herds. Pamphlet gives detailed figures and pictures of cows of various grades. *Iowa State College of Agriculture, Ames, Iowa.—Gratis.*

Plant Patents (Reprinted from January 1931 Journal of the Patent Office Society) by Joseph Rossman, Ph.D., deals with the recent amendment to our patent statutes covering the inventions of anyone "who has invented or discovered and asexually reproduced any distinct and new variety of plant other than a tuber-propagated plant." The plant breeder as an inventor is a novelty. *Address Dr. Joseph Rossman, U. S. Patent Office, Washington, D. C.—Gratis.*

The Photoflash Lamp, Its Characteristics and Applications. These new lamps do away with the smoke of flash powders. The entire flash takes place inside a glass tube and thus all smoke, odor, and noise are eliminated. They enable excellent pictures to be taken in the home. *General Electric Company, Nela Park Engineering Department, Cleveland, Ohio.—Gratis.*

Lighting for Seeing by Dr. M. Luckiesh and Frank K. Moss. In this bulletin are given systematized glimpses of the results of scientific investigations, which aim to show that this new science of seeing is the result of a partnership of lighting and vision. It is well illustrated and contains much scientific data. *General Electric Company, Nela Park Engineering Department, Cleveland, Ohio.—Gratis.*

Light Frame House Construction (Bulletin No. 145, Trade and Industrial No. 41, issued by the Federal Board for Vocation Education in co-operation with the National Committee on Wood Utilization) affords a splendid compilation of technical information for the use of apprentice and journeymen carpenters. It is a large pamphlet of 216 pages and there are 163 illustrations and many diagrams. A most valuable book on carpentry as applied to house construction. *Superintendent of Documents, Washington, D. C.—40 cents (money order).*

THE SCIENTIFIC AMERICAN DIGEST

(Continued from page 273)

20 pounds or more above normal weight had enlargement of the heart, whereas only 5.3 percent of those who were 20 pounds or more underweight had any disturbance of the heart whatever.

As an evidence of the importance of careful periodic physical examination, it is pointed out that the 1000 mechanics showed significant defects in 83.6 percent of cases, and that actually 88.5 percent of the men had defects of some kind of which they had not the slightest knowledge and which they had not complained.—*M. F.*

Vacuum Clutch Control

TO many automobile drivers to whom the strain of depressing the clutch pedal for every change of gears is onerous, a new vacuum clutch control produced by the Hill Engineering Corporation of Richmond, Virginia, will afford a welcome relief. This device draws power from the intake manifold to depress the clutch pedal and release the clutch when a button on the gearshift lever is pressed.

When the button on the gearshift lever is pressed, it raises a piston valve, thereby connecting a vacuum chamber to intake suction, raising a diaphragm and its rod which pulls the clutch out of engagement by a cable running over pulleys.

The upward movement of the diaphragm rod releases the tension on the lower coil *spring, allowing the upper coil spring to* open the atmospheric valve in readiness for subsequent clutch engagement.

When the button on the gearshift knob is released, the piston valve moves down, cutting off suction and allowing air to rush into the vacuum chamber, thus relieving the pull on the clutch cable and allowing the clutch to begin to engage. However, before the diaphragm rod has moved down very far, the resulting i…

on the lower coil spring closes the atmospheric valve, and thereafter air can enter the vacuum chamber only through the small bleeder hole. This slows up the downward motion of the diaphragm and permits the clutch to engage smoothly. The bleeder opening is adjustable by a set screw so that the rate of engagement may be varied as desired.

After the shift is completed, the hand, as usual, is removed from the lever, the button is released and the clutch takes *hold smoothly and automatically.* Releasing the button permits a swift return of the clutch pedal until it is automatically checked just before engagement.

In traffic, if the driver wishes to remain in gear for a quick start, he shifts to the desired gear and holds his thumb down on the button until ready to go.

The car may be allowed to coast by holding the button down. A double clutch operation can be made as rapidly as desired in changing speeds.

Duck Speed

A MALLARD duck banded on November 23, 1930, at Big Suamico, Green Bay, Wisconsin, was killed five days later near Georgetown, South Carolina, according to a report to the Bureau of Biological Survey of the United States Department of Agriculture. This is a record for individual speed of migration, the bureau says.

Moto-vita Addenda

WHEN the article on the Moto-vita, published on page 92 of our February issue, was prepared, the editors were *given to understand that the device de*scribed was to be placed on the market very shortly for use on motor cars. Therefore, this fact, and the fact that it would sell at a low price, was stressed

Since the February number

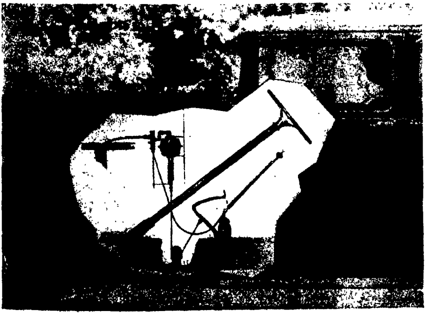
lished, we have been informed

Moto-vita is being developed, at tl

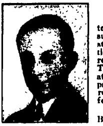
time, exclusively for use on air

large marine engines and that it

year or more. It can be furnished to thos



With this new vacuum clutch control, the driver does not have to press the clutch pedal with his foot. A touch on the button on the shift lever does the trick



Encouraged by $100

"Perhaps you will be interested to learn that I have succeeded in selling a short story to 'War Birds,' aviation magazine, for which I received a check for $100. The story is the first I have attempted. As the story was paid for at higher than the regular rates, I certainly felt encouraged."

Darrell Jordan,
Box 277, Friendship, N. Y.

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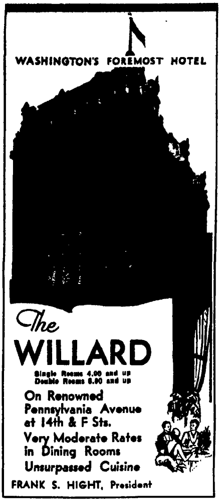

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An ice-cream truck refrigerated with Dry-Ice

interested at this time, but the price, for use on the average private car, is exhorbitant. When the present development work on the device for aircraft and marine engines is complete, it is planned to produce simplified units operating on the same principle and at a price within the reach of all motor-car drivers.

Cancer in Savages

THERE seems to be a common belief, largely promoted by faddists who are trying to secure a return from present diets to less complicated foods, that savages do not suffer from malignant tumors as do members of the white race. The argument is made that savages eat a diet consisting largely of fruit, nuts, and whole wheat, and that they do not have cancer in the same proportion as does the white man. The actual facts of the matter are that savages are not immune to cancer. Research carried on in the Belgian Congo recently revealed 34 cancers found by physicians among the natives of various regions.

The investigators conclude that, far from being refractory to cancer, the black race presents all of the forms of tumors that are encountered in the white race. One reason why the savage does not have cancer in the same proportion as does the white man is the fact that he does not live long enough to die of cancer. Cancer is essentially a disease of advanced age. Whereas the white race has a life expectancy of from 55 to 60 years, the savage race still has the life expectancy which formerly characterized civilized man; namely, from 30 to 35 years. Apparently there is not the slightest scientific evidence to indicate that the eating of any diet or any particular kind of food will in any way increase or lessen the incidence of cancer in any group.—*M. F.*

Sears, Roebuck and Company Stronger

REPORT of Sears, Roebuck and Company for 1930 will show a stronger financial position than was at first thought possible.

Notes payable at the end of the year were down to 17,000,000 dollars, a decrease of almost 14,000,000 dollars from the 30,798,000 dollars at the end of 1929. First estimate was that notes payable would be reduced only 7,000,000 dollars to 10,000,000 dollars, and a later estimate indicated a decrease of something over 10,000,000 dollars. The company also paid off during the year purchase money mortgage notes amounting to 1,018,172 dollars.

Despite the large reduction in notes payable during the year, Sears, Roebuck was able to end 1930 with an indicated increase of at least 2,000,000 dollars in cash over the figure of 7,089,500 dollars in cash at the end of 1929.

Sears, Roebuck and Company is not contemplating new financing through note or bond issue, or by any other means, according to company officials.

Following the announcement of its spring and summer general catalog, with about 1000 pages and 48,000 items, President Wood said: "Taking advantage of low basic commodity prices, our buying organization has made possible new lower costs to the public. In many lines they represent an all-time low. These reductions are in keeping with our policy to pass on to our customers any savings we have been able to effect."

Approximately 7,000,000 copies of the catalog will be distributed this spring. Prices therein will be in effect six months. Reductions are from the 1930 spring catalog, which was substantially lower than the 1929 book.

Minimum time payments have been reduced from five dollars a month to four dollars, and minimum purchase on time payment has been reduced from 25 dollars to 20 dollars. This 20 percent reduction is considered in line with the reduction in merchandise prices.

The center of the catalog illustrates a new plan under which a complete home modernization offer is made available under a single time-payment contract. Roofing, plumbing, electrical fixtures, lumber, and millwork purchases are all combined. The company provides the material to complete the contract, which carries an 18-month payment period.—*Barron's.*

Dry-Ice Refrigerated Truck

A NEWLY developed Dry-Ice refrigeration truck, with its light weight, elimination of corroding brine, and maintenance of lower temperature, is attracting the interest of ice cream manufacturers and dairymen.

Mounted on a six-cylinder White truck with balloon tires, is a three-compartment body. Two compartments are used for carrying bulk ice cream in cans, the third carrying special trays for package ice creams.

Refrigeration is accomplished by using solid carbon dioxide as the refrigerating medium, which has a temperature of 100 degrees below zero. This refrigerant looks like a block of tightly packed snow and is usually a cube about 10 inches on a side, weighing approximately 40 pounds. This Dry-Ice evaporates without moisture, giving off a gas that is circulated through the body.

Each compartment which is refrigerated with its own Dry-Ice, consists of an inner compartment containing the ice cream, with a galvanized iron tank for carrying the refrigerant. Entrance to the refrigerant tanks is through the roof of the truck body, which permits the filling of the ice cream compartments after the truck has been "iced."

The gas travels in a definite direction around the compartment between the inner metal compartment and outer walls. It returns to the top and is discharged through a metal port fitted with a control valve. With this valve the driver can control the speeding up or retarding of the evaporation of the refrigerant. The blanket of cold gas also acts as additional insulation and carries off heat that might pass through the outer walls of the body.

This type of refrigerator body, with the required amount of refrigerant, is much lighter than ice and salt refrigerated bodies, making it possible to deliver the same amount of ice cream with trucks of lighter capacity. Another advantage is that the Dry-Ice evaporates without moisture, reducing depreciation and maintenance cost of the trucks.

Chemical Stimulation of Red Blood Cell Formation

IN 1926, Doctors G. R. Minot and W. P. Murphy of the Harvard University Medical School demonstrated that the feeding of liver to a person with pernicious anemia produced an increased number of young and old red blood cells. Thereby was developed the control of what was formerly considered an invariably fatal disorder. It soon became apparent that the eating of large amounts of liver, either cooked or raw, could be exceedingly tiresome and distasteful. At first, methods were devised for making the liver more palatable by modifying the nature of the cooking. Eventually, biologic chemists were able to obtain from the liver a crude extract which seemed to have all of the virtues of the whole liver in stimulation of the red blood cell formation in pernicious anemia. These extracts could be taken as powder and thus the patient coul

whole liver

Not long

versity of Michigan showed that extract of the wall of the stomach served the same purpose, and could be purchased at a cheaper price than the original liver extract. However, either one of these extracts represents a cost to the patient of from three to five dollars per week and thus is a considerable drain on the purse.

The biologic chemists have not ceased their researches, however, and it now seems likely that they have isolated chemically a pure substance which serves the purpose of the liver or of the liver extract. It is a protein derivative, representing a compound of beta-hydroxyglutamic acid and hydroxyproline. Obviously the development of a pure chemical will lead eventually to a cheaper price for treatment and the possibility of a more accurate control of the disorder.—*M. F.*

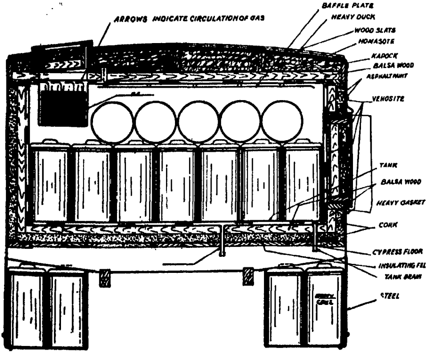
Using and Preserving Excess Honey

HONEY production in Canada is growing rapidly, says S. J. Cook in *Industrial and Engineering Che*

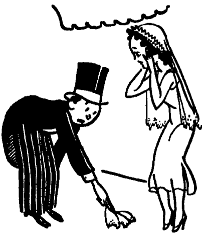
23,196,493 pounds in 1927, the yea

put rose to 25,574,798 pounds i

39,978,735 pounds in 1929. There is a relatively small export trade, chiefly to Great Britain, but the total shipments to all countries do not exceed 2,000,000 pounds annually. Consumption in Canada is not keeping pace with the increased supply,



A cross-section of the truck shown on the opposite page, showing position of units and flow of cold gas. Dry-Ice is in the shaded compartment at upper left


Only a *handkerchief*

BUT it was no joking matter to the bride. Someone had stepped on her "going away" handkerchief. The rare little bit of handed-down lace was crumpled and soiled. And it had to be washed with infinite care. Could we? We could and did.

We rather pride ourselves on our ability to take care of our guests. You'll find it reflected in rooms that have closets big enough to hold *all* your clothes—in *every* appointment which a hotel worthy of the name provides. But what you'll be sure to notice is a spirit of *extra* service, in all the little things which United Hotel employees are taught to take the time to do well!

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NEW ORLEANS, LA. .... The Roosevelt
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TORONTO, ONT. .... The King Edward
NIAGARA FALLS, ONT. .... The Clifton
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ICA, B.W.I. . The Constant Spring

Cathartics Are Dangerous

For nausea, for cramps, for colds—or for simply what ails them, people take cathartics. They never consider that powerful stimulants might be able to stir up serious trouble in the bowels, the stomach, the gall-bladder and the intestines. Dr. Bernard Fantus in his article, "The Use and Abuse of Cathartics" appearing in the April issue of HYGEIA, the Health Magazine, describes the action of the more commonly-used cathartics. He shows how they are, sometimes, most treacherous when they seem to be most effective.

▼

HYGEIA is fertile with the wisdom of Health

Dr. Fantus' article corrects the mistaken views of laymen about cathartics—all HYGEIA articles aim to correct erroneous and harmful health ideas, to dispel superstition, and to replace ignorance of health problems with knowledge—to enable people to live all-around healthy lives. HYGEIA contributors are men and women active in health work, or actually practicing medicine. HYGEIA'S style is chatty, [illegible] nical. Here are a few of the articles appearing [illegible] with that of Dr. Fantus in the Apr[illegible]

"The Patient's Part in Tuberculosis", good material for individuals in a home where a tuberculous patient lives; "Eggs for Easter and Other Seasor..", [illegible] properties of eggs a[illegible] giving a number of [illegible] ways to cook them; "The Mouth—An Open Road to Health and Disease", suggestions for preserving the teeth through old age; "Cooperative Exercises for Mothers and Children", telling how parents can develop a comradely spirit with their children, and how both children and parents can achieve grace [illegible] informative articles appearing in April—and, in addition, there are two health stories for children.

▼

special introductory offer

The regular subscription price of HYGEIA is $3.00 a year, but to spread health knowledge as widely as possible—to disseminate health knowledge in the most rapid and pleasurable manner, the special introductory offer is made to new subscribers—6 months of HYGEIA for $1.00.

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Enclosed find $1.00 to cover the pric[illegible] months' subscription to HYGEIA, the H[illegible] azine. I am a new subscriber.

and the industry has turned to scientific research with the problem of finding wider markets, either through the development of new uses in Canada or by the enlargement of export trade outlets. In the meantime there is a demand for an effective means of preventing losses by fermentation during storage.

It is now generally recognized that fermentation spoilage of honey is caused by sugar-tolerant yeasts, capable of restraining the growth of the ordinary yeasts. Tests of hive nectar, made throughout the season, indicate that infection with the sugar-tolerant yeasts is constantly present; hence, while strict sanitary precautions during production help to prevent loss by spoilage, they are not alone sufficient. Sodium benzoate, sodium sulfite, and sodium bisulfite are all effective within the permissible concentrations, and these three are the only ones out of the chosen list which seem, from the preliminary results, to be worth further testing on a practical scale.—*A. E. B.*

Potassium Phosphate Lubricates Where Oil Is not Suitable

THE use of non-oxidizing lubricants is required in certain chemical operations *where oxidizing materials*, such as potassium chlorate or peroxides, are handled. For this purpose, German chemists have developed a lubricant which is merely a solution in the form of highly concentrated potassium phosphate (K_2HPO_4). With a specific gravity of 1.8, the solution has the properties of a medium machine oil at 20 degrees, Centigrade, viscosity of 20 Engler degrees, and at 50 degrees a viscosity of 4 [illegible] degrees. It is produced by [illegible] neutralization of technical phosphoric [illegible] with solid caustic potash. By the addition [illegible] moval of undissolved particles the solut[illegible] the proper consistency. It can also be mix[illegible] and other such useful fillers.—*A. E. B.*

New Rust Preventive Agents

TESTS have recently been carried out on two new rust preventi[illegible] called "Herolith" and "Tornesit," by t[illegible] nnesmann Tube Works.

Herolith is a synthetic resin and is applied by brushing, prior to which scale is removed by pickling. Tubes coated with it have successfully withstood thorough mechanical and chemical tests, the former comprising tests for resistance to shock, scratching, and conveyance by train or motor-lorry. Thirty-five corrosive agents were used in the chemical tests, only three of which (hydrofluoric acid, caustic potash solution, and caustic soda solution) had any effect on the tubes. Dry heat up to 220 degrees Centigrade, and intermittent temperatures up to 300 degrees Centigrade, do not injure the coating. Steam tests, not yet concluded, have so far given good results.

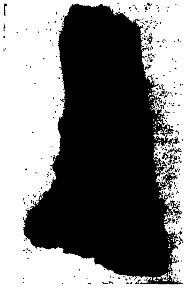
The other agent, Tornesit, is a rubber product similar in appearance to cellulose. It can be brushed on the part to be protected without preheating being necessary, and dries in three minutes. It hardens to such an extent after a few hours that even heavy hammer blows do not damage the coating. In contrast to Herolith, Tornesit is resistant to alkalis, and is attacked only by hydrogen sulfide, water, benzol, acetone, and aniline. It can be employed as a protective coating for iron and steel, wood, brickwork, and concrete.—*A. E. B.*

Oldest Wood Found

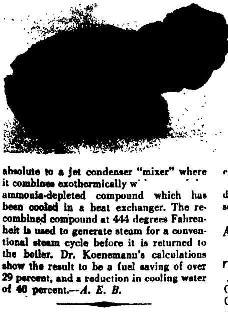
WOOD about 20 million years old—and still wood! Not petrified or replaced by other materials but definitely recognizable and largely in its original condition. The accompanying illustrations are of such a piece of wood recently taken from the tunnel of the inverted siphon or under-pass on the line of the main canal of the Kittitas Division, Yakima Project, United States Reclamation Service, near Ellensburg, Washington, and preserved by Mr. Gerald L. Perry, of Seattle.

This specimen was part of a tree completely embedded in an upright position in the Yakima basalt. On the canyon wall above the river is exposed the Ellensburg sandstone which definitely places this wood as belonging to the middle Miocene Epoch. Calculations based on the radio-activity of certain minerals has placed the Miocene Epoch somewhere between 19 and 23 million years in the past.

The accompanying illustrations clearly show the texture of the wood and also show the deposits of an iron sulfur compound in the grain of the wood. A close inspection shows this mineral deposit to be partially iron pyrites, but mostly a combination of sulfur and iron deposited at a much lower temperature than ordinarily accompanies the formation of iron pyrites. The wood itself is somewhat blackened, either by age or heat, still shows the grain, will burn if ignited with a match, and has all the appearance of an old weathered piece of redwood, with the exception that its color is generally darker throughout and it lacks the characteristic odor of redwood. At the point where the mineral salts touched the wood, careful study shows an apparent forcing of the metal into the grain of the wood and a darkening effect in the wood which might be caused by an acid reaction or high temperature. From this evidence we could assume that the deposits of iron were



One side of the piece of aged wood showing the grain and the iron deposits which were forced into top either made by precipitation from hot gases shortly after an eruption or from hot water (carrying an acid reaction) at a later period. Apparently these trees carried considerable bark and what appears to be a portion of this bark, carbonized by the heat, is to be seen on the specimen. Undoubtedly the moist bark of the tree protected the wood itself during the period of high temperatures.



Bottom of the specimen of old wood with a space polished to show the curve and grain of the ancient trunk. Iron deposits are on the upper part in this picture

Ammonia-Steam Cycle for Power

MENTION has been made in these columns of the mercury boiler in which the heat supplied the boiler is made to work twice, by first vaporizing the mercury and then, at a lower temperature, vaporizing water to steam. Now, a new combination is proposed, involving a chemical principle and the use of ammonia. The plan is described in a recent issue of *Power*, in an article based on an interview with a

 er, Dr. Ing. F. Koenemann,

s proposed a binary power genera-

n cycle employing ammoni

nia carrier in the primary stage, and

am in the secondary stage.

Dr. Koenemann's process depends on the fac

e molecule of ammonia at high temperatures, while the resulting $ZnCl_2NH_3$ vigorously takes up a molecule at a lower temper-

e. The first effect absorbs heat and the second liberates heat. When

salt is heated in a boiler, it melts, and in a typical case, gives off ammonia at 100 pounds absolute pressure and 896 degrees Fahrenheit. After the ammonia has produced power in a turbine, it is exhausted at 239 degrees Fahrenheit and one pound absolute to a jet condenser "mixer" where it combines exothermically w

ammonia-depleted compound which has been cooled in a heat exchanger. The recombined compound at 444 degrees Fahrenheit is used to generate steam for a conventional steam cycle before it is returned to the boiler. Dr. Koenemann's calculations show the result to be a fuel saving of over 29 percent, and a reduction in cooling water of 40 percent.—*A. E. B.*

When a Chemist Waxes Poetic

FROM time immemorial, poets have sung of the deep blue sea, its beauty and its mystery. It is doubtful, however, if the ocean was ever before addressed in the language of a chemist as Norman L. Knight phrases his ode in a recent issue of *Industrial and Engineering Chemistry*.

"O Sea! Thou saline and undulant aqueous solution of halides, carbonates, phosphates, sulfates, and other soluble inorganic

dal What mysterious colloids are dispersed within thy slightly alkaline bosom? What silent and unseen reactions vibrate in dynamic equilibrium, constantly destroyed and instantly restored, among thy unnumbered oscillating molecules? What uncounted myriads of restless ions migrate perpetually throughout thy tentatively estimated volume? What unguessed phenomena of catalysis, metathesis, and osmosis transpire in thy secret fluid profundities under excessively increased pressure? What cosmic precipitates descend in countless kilograms upon thy argillaceous, gelatinous, siliceous, diatomaceous, and totally unillumined bottom? In short, most magnificent reservoir, what is thy flow-chart and complete analysis?"—*A. E. B.*

Chemical Treatment of Foods

IF ONE looks over the list of radically new developments made during the past year or two he finds a surprisingly large number of cases in which the ir

a new chemical for foodstuff tr

progress, says *Foo*

Ethylene for m

for blanching of c

improvement in merchandising practice l

at once followed the development of sat

factory mold-control.

Disinfection for control of insects and rodents about food plants is increasingly important and, fortunately, increasing

easy. There ar

deserve conside

scientific and technical a

Amber Laboratory Ware Resists Corrosion

TRANSPARENT, hydrofluoric acid-proof vessels have not hitherto been known. Glass is rapidly attacked by this acid. Two German chemists, C. Plonadt and A. Eisenack recommend for this purpose vessels of clear molded amber, which are produced and sold by the Staatliche Bernst

Konigsberg. These relatively cheap amber reagent glasses, beakers, dishes, and so forth, are completely resistant to concentrated hydrofluoric acid, as well as to 50 percent potassium hydroxide at water-bath temperatures. Even after four weeks no loss of weight was determinable. On the contrary, a small increase of weight occurred with hydrofluoric acid as a result of the absorption of the acid by the resin. This,

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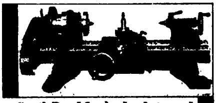

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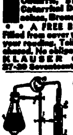
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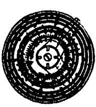
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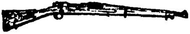
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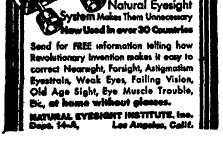
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however, apparently caused no injury. If a thin layer of paraffin oil or, better still, molten paraffin is poured upon the reacting fluid previous to heating, the operations in the amber vessels can be carried out at water-bath temperatures with an entire absence of odor. The layer of oil prevents the evaporation of the hydrofluoric acid.—*A. E. B.*

Attributes Blue Color of Sea to Chemicals

WHAT makes the ocean blue? The usual answer has been that the color iply the natural physical property of water in large quantities. Now, however, a prominent German chemist asserts that the blue is due to certain chemicals which impart the hue to the sea. The question arose when Richard Willstätter and F. Haber, on a trip to the Canary Islands, began discussing the color of the briny deep. Whereas Haber preferred the well-known physical explanations, Willstätter believes that the blue, which is visible even in such a thin layer as in a bath tub, is due to dissolved, complex copper compounds of the nature of the cupri-amino salts. The conditions for their formation are present because of the known content of copper in sea water and the formation of ammonia and especially of organic amino compounds as a result of the decomposition of proteins. Dr. Haber is generally regarded as one of the greatest of German chemists. It was he who developed the synthetic ammonia process which played such a prominent part in Germany's war preparations.—*A. E. B.*

Road Funds Available

FEDERAL road funds available for new rc ad projects on the federal aid sys- ıl 235,383,877 dollars, says Secretary of Agriculture Hyde. Of ıut 80,000,000 dollars was provided by ıf Congress of December 20 for emer- employment. This fund may be used by states in place of state funds to match regular federal aid funds previously apportioned.—

Vegetable Oils Solidified

FOR many purposes it is desirable to package and ship essential, mineral, and vegetable oils in a semi-solid form. Particularly is this the case with perfumes, lotions, ointments, concentrated deodorants, and many technical specialties for lubrication, tube paints, hydraulic fluids, and so on. For these purposes trihydroxyethylamine linoleate is now being used. It is marketed as a viscous amber oil, slightly alkaline in nature, possessing a faint odor, and soluble in water, alcohol, hydrocarbons, and oils.

If one part of this compound is mixed with one part of an essential oil and one of water, a stiff jelly results which does not lose its consistency with age. Larger amounts of water may be added slowly with stirring. The mixture gradually becomes less viscous, and after a certain excess of water has been added it becomes a typical milky emulsion. This latter phenomenon has been applied technically in producing so-called water-soluble oils, which consist of equal parts of trihydroxyethylamine linoleate and the oil. When this mixture is thrown into water a milky emulsion of the oil is formed. In disinfectant and deodorant sprays, where a slight turbidity is not objectionable, this method has eliminated the use of alcohol and other inflammable solvents and, in addition, has lowered manufacturing costs.—*A. E. B.*

New Products from Gypsum

SEVERAL new products consisting primarily of gypsum were introduced during 1929 and may lead to an increasing use of this material, according to the United States Bureau of Mines. An extremely hard dense plaster, suited primarily for architectural casting, was recently placed on the market. On the west coast, producers of gypsum products have developed a wall board that may be bent or folded to conform to structural needs. Gypsum lath that folds and is more or less flexible so as to simplify its application to intricately designed interior structures was also a new development. A new method for fastening wall board and lath to steel structural members was devised. Considerable research work was done to develop acoustical wall boards, and gypsum acoustical ducts that prevent the transmission of sound through ventilator shafts were placed on the market. Some companies are now producing artificial travertine, using gypsum as the principal material.

A process was patented for casting concrete objects in porous plaster molds. The plaster molds absorb a considerable portion of the water in the concrete mixture, resulting in concrete of great strength.

In the middle west and east the manufacture of gypsum lumber n able progress during the year, and it is reported that the future of this gypsum product is very promising.—*A. E. B.*

OUR POINT OF VIEW

(*Continued from page 231*)

have almost been stampeded by the specter they have conjured up of a super-eco- ›m based grotesquely enough ›rm of peonage, approximating slavery, (2) the employment of the latest machinery, (3) the consolidation of the whole people into an industrial unit, and (4) the efficient co-ordination of their industrial efforts by the government. This economic colossus is supposed to develop the raw resources of Russia so efficiently that their exportable surplus of raw and semi-finished goods will flood world markets and undermine our present economic superiority.

The Russian government has been shrewd enough to encourage these fears. For example they assert that they will grow cotton in such quantity that they will break the cotton price just as some people claim they did the wheat price. They make extravagant claims of industrial progress.

Russia possesses enormous latent raw resources and she has a fecund, stolid peasantry capable of surviving almost any degree of human misery; it is quite possible that the breaking up of the great landed estates will eventually increase the efficiency of her agriculture; the enthusiasm of those who sincerely believe in Leninism and the dictatorial energy of their governing group may force the adoption of modern machinery in her factories and on her farms.

Now we possess raw resources in abundance, our population is still essentially a mass of producers, and while our wage-scale and standard of living at first thought may seem a handicap in foreign markets, actually it has forced our employers to standards of efficiency that have enabled us to more than hold our own. Our own previous history supplies the negative to every single proposition advanced in favor of eventual Soviet economic domination of the world.

In our colonial days English theorists vainly tried on a small scale the "common stock" idea that is the essence of the Leninism or Marxism; the southern states proved before 1860 that slavery was economically unsound; under the pressure of the World War, with a more intelligent government than obtains in Russia to-day, we tried to consolidate industrial America, and from the operation of the railroads to the airplane program we failed miserably. Under this same imperious war demand we tried to distribute our skilled artisans to the best advantage; anyone acquainted with the actual development of our war industries can tell how inefficiently we handled our labor. In an almost hysterical fear some of us assume that Russia can succeed where we so signally failed, yet in a machinery age, Russia has to import not only machinery *but also the experts* to keep it in order, and in a civilization that has been created and dominated by nations believing in the fullest individual development, Russia pins her hopes on a tem that sacrifices the individual to [illegible]

Russia will normally have an exportable surplus of wheat and flax; if she employs foreign managers she can supply the world with certain minerals such as manganese and with lumber. She did this under the Czars and we managed to survive. The only danger from Russia is that some of our parlor socialists and some of our unskilled alien labor will imbibe the fatuous ideas of Lenin and press them on our people, many of whom, bewildered by the rapid industrial developments since 1900 and the kaleidoscopic events of the World War, are too ready to listen to high-sounding phrases instead of doing a little quiet reflection for themselves.

Australia's Financial Plight

AUSTRALIA is now facing a crisis in her government fiscal policies. Briefly, Mr. Lang, Prime Minister of New South Wales, proposes that the Australian Commonwealth and state governments shall pay no more interest on their bonds, mainly held in England, until, first, Britain scales down Australia's debt as we did Britain's war debt to us; second, domestic holders of bonds agree to accept a reduction of interest to 3 percent; and third, the Commonwealth Government definitely abandons the gold standard.

The importance of Mr. Lang's proposal comes from the fact that the debt of New South Wales exceeds that of any of the other states and that he frankly advocates partial repudiation. London does not fear the adoption of this plan of open repudiation but it does fear an alternative plan recommended by Mr. Theodore, Federal Treasurer, which means inflation that would further increase the present crisis.

The sound but drastic plan to reduce the Australian government expenditures, to revise old age, invalid, and war pensions downward, excited too much opposition to be adopted. Before the war, Australia had embarked on ambitious but ill-considered socialistic plans that fastened extraordinarily heavy charges on the public treasury. The war placed additional strains on an already hard-pressed treasury. The government hesitates to inaugurate the only sound method of restoring Australian solvency.

Advices from London indicate that Britain will come to the financial aid of her dominion if necessary to prevent her bankruptcy. But this will only mean an additional burden on the treasury of the United Kingdom. Even school-boys should realize by now that governments as well as individuals must balance budgets, but enthusiastic advocates of state aid for various worthy enterprises always forget the teaching of experience and cheerfully look into the government's purse for some miraculous supply of gold only to find that the government has no money except that provided by the taxpayers. Our Congress and State Legislatures will do well to ponder Australia's condition when confronted with wholesale demands for government aid, all of which have to be financed by the citizens' money.

France, England, and the Iraq Oil

WHILE oil producers the world over are striving to control and reduce the current production of oil, which already exceeds the world's demands, a French company backed by the [illegible]nch government is prepar[illegible] completion its section of pipe-line from the Iraq oil fields to Tripoli, Lebanon. The proposed British terminal of this same pipe-line will be at Haifa and will serve both British and American oil companies interested in the Iraq fields.

The British and American interests do not wish to hasten construction of their end of the pipe-line and at present contemplate leisurely construction with completion about 1938. France, eager to obtain a supply of oil wholly under her own control, desires to finish her section in 1933. As both French and British titles to the oil fields come from the World War, there has already been much negotiation on the division of the oil. American interests depend upon concessions obtained from the Turkish government prior to the World War, and recognized by the Allied gov[illegible]ments after th[illegible]

It is easy to understand both the French desire to control its own supply of oil, and the opposition of the British and American companies already struggling with a world over-production to an additional supply thrown on the world market. We have watched the desperate and to-date futile efforts of domestic oil companies to control the output of oil in the United States. American companies are only hampered by anti-trust laws and the natural desire of owners of oil wells to realize on their underground resources. The Iraq situation is complicated by its international status and the fact that three governments are supporting the views of their respective companies. The future developments will be interesting to observe.

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COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar

Stocking Repair Method Patent Held Valid

THE Court of Appeals of the District of Columbia recently affirmed the decision of the Supreme Court of the District of Columbia, holding claim 23 of reissue patent No. 16,360, issued to The Stelos Company, Inc., assignee of Frank C. Stevens, the inventor, valid and infringed.

The Stevens invention was found by the Court to have revolutionized the art of repairing runs in fabrics and particularly in hosiery. Prior to the Stevens invention runs in hosiery were repaired by stretching the stocking over the finger tips, which method made it difficult to insert a needle beneath the thread, and moreover was slow and was trying to the eyes. Stevens conceived the idea of stretching the fabric or stocking over a holder having a depressed surface with sufficient depth for the free use of the needle. The needle which he devised comprised a hook at one end, a latch or bridge pivoted adjacent to the hook and in position to open and close the latter with the operation of the needle, and a notch or recess at a point opposite the free end of the latch or bridge. By employing the recessed holder this needle could be used eciprocating manner to pick up the threads in the run faster than the eye could follow the operation and with but one forward and one backward motion to accomplish the purpose for which previous methods had to use twice the number of forward and backw

The Stevens reissue patent covers both the needle and the method by which the needle is used to repair the runs, although only claim 23 for the method was involved in the above mentioned suit. The use of the special holder in the method was regarded by the Court as revolutionizing the art, and caused the Court to remark: "Its simplicity now that Stevens has disclosed it, causes wonderment that it had not been discovered before."

"Kalas-Sill" Not Registrable as Trademark

IN an appeal from the decision of the examiner of trademark interferences dismissing the opposition, First Assistant Commissioner Kinnan recently held that the applicant, Olaf Hertzwig Trading Company, Inc., is not entitled to register the words "Kalas-Sill" as a trademark for canned herring.

It was shown by the opposer, B. Westergaard and Company, that the words are considered as descriptive in Sweden, meaning substantially "banquet herring" and that the Swedish government refused to register the notation on the grounds that it "seems to indicate the nature and purpose of the goods." A notation that is descriptive in Sweden and when used by Swedish people is not registrable in the United States [illegible] a trademark.

MR. LIDDY will be pleased to answer the inquiries of our readers who may desire information relative to the various subjects reported in his department.

—The Editor.

It was further shown that the earliest use of the words by the applicant was about August 1, 1924, whereas the opposer sold goods bearing the words as early as February, 1924. It was held in consequence that the applicant had not established itself as the owner of the mark.

Therefore the decision of the examiner of trademark interferences was reversed, the opposition sustained, and it was adjudged that the applicant is not entitled to the registration for which it had applied.

Correspondence School Curbed

C. N. COX, who conducts a correspondence school in Denver under the name The Norton Institute, is ordered by the Federal Trade Commission to cease representing that a "C. H. Norton" is president of the so-called institute or has any connection with the busi

"C. H. Norton" was found to be fictitious.

Other prohibitions pertain to prices charged for the course, advertising, and representation regarding preparation for

Cox is ordered to stop representing that prices of the courses are other than the prices at which they are actually sold. He is to discontinue publishing letters of recommendation unless they are genuine and actually received by him and to stop representing in newspaper advertising or "Help Wanted" columns that he does or can furnish the position of forest ranger. Representation that the course in forestry is sufficient adequately to prepare persons to take United States Civil Service examinations for the position of forest ranger is also prohibited, unless and until the course of instruction be modified so as to afford information on every subject included in the examination.

The so-called institute is conducted by Cox and one clerk in a portion of two office rooms.

The course in forestry was found to be inadequate because for one thing it did not show the necessary ages for qualification under the civil service rules, which omission might cause numerous persons outside the age limit to spend money for the course when they could not benefit therefrom. In addition, the course was found to give misinformation regarding the number of questions in the examination, also to contain several erroneous answers and not fully to cover the subjects as prepared by the Civil Service Commission.

Furthermore, there is no mention as to necessary experience that applicants must have had in order to pass the examinations when, as a matter of fact, the only people who pass them and obtain appointments are those with actual field and forest experience. It was found that in examinations held by the civil service, out of 80 competitors who stated they had taken The n Institute course, only four passed the examination and the papers of the four showed them all to have had experience.

Speckled Coal Marks Refused

IT was recently held by First Assistant Commissioner Kinnan that the Blackwood Coal and Coke Company, of Philadelphia, Pennsylvania, is not entitled to register as a trademark for coal, a mark described as consisting "in a plurality of blue specks of irregular size on the surface of the lumps, no claim being made to the lump of coal *per se*."

The ground of the decision is that the Delaware, Lackawanna and Western Coal Company, of New York, had previously used and registered as a trademark for coal, a mark consisting in coloring the surface of some of the lumps of coal in the mass blue, and that applicant's mark is so similar thereto that the contemporaneous of the two would be likely t confusion.

In his decision, after stating how opposer had used its mark, the First Assistant Commissioner said:

"It is believed to be obvious enough that purchasers would be quite likely t designate the applicant's goods as 'blue coal.' From the specimens filed and the testimony presented it is deemed the examiner of interferences was fully justified in his conclusion that the goods of the respective parties, when viewed at such a distance that the general color effect of the entire mass would be observed, would appear to the average purchaser as quite similarly marked and confusion would be practically certain if the marks appeared upon the respective goods in the same market."

Gas "Dope" Complaint Dismissed

THE Federal Trade Commission has dismissed a complaint charging E. K. Whitney and others, of Providence, R. I., trading as Motor Snap Company and as Whitney Sales Company, with circulating misleading statements regarding higher engine efficiency obtained by placing tablets in the gasoline tank of a motor vehicle.

Building Design Judged Patentable

AN appeal was recently made by Wilbur B. Foshay and Gottlieb R. Magney from the action of the primary examiner in finally rejecting the following claim:

"The ornamental design for a building, as shown."

The opinion of the Patent Office Board of Appeals follows:

Appellants' design is for a building which resembles in appearance the Washington Monument. The Examiner, in his statement, says the claim is not rejected *on the ground that the design is a simulation of the Washington Monument*, and the only references cited have been withdrawn as such. He further states that the claim was finally rejected on the sole ground and for the sole reason that it is not proper subject matter for a design patent as contemplated by the design statutes. Accordingly, this is the only question that is before us for consideration.

In the case of In re Hadden, 1927 C. D., 160, the Court of Appeals of the District of Columbia held a grand stand to be proper subject matter for a design patent. The examiner asserts that the Hadden decision *is not controlling in the instant case* for two reasons. The first of these reasons relates to the clearness of the disclosure in the Hadden application drawings. It is not seen how this reason has any bearing on the question of whether or not a large building structure may properly be regarded as an article of manufacture under section 4929, Revised Statutes.

The second reason advanced by the examiner is that the court was not fully advised of a prior Commissioner's decision rendered in 1890 and of the Patent Office practice following such decision, and that in view of these facts, as well as the decision of the Supreme Court in the cases of Jacobs *vs.* Baker, 7 Wall. 295, and Fond du Lac Co. *vs.* May, 137 U. S. 395, the decision in the Hadden case is erroneous. The early Commissioner's decision can be regarded as in no sense constituting a precedent which would be binding upon the appellate court. The Supreme Court decisions were considered in the Hadden opinion. We are satisfied the Hadden decision is controlling in the instant case as to the sole ground of rejection involved in the appeal.

In one of the early actions in the case the examiner required division between Figures 1 and 2 on the one hand and Figure 3 on the other hand. At that time he indicated that Figures 1 and 2 show a patentable design. The applicant attempted to comply with the requirement by asking that a print of Figure 3 be made for this application and sheet 2 of the drawing, which contains Figure 3, returned so that a divisional application might be filed.

The examiner's subsequent actions denied patentability of the claim, and it does not appear what his attitude is at the present time with respect to the question of division. Applicant in his brief asks us to rule in view of amended Rule 41 that all three figures may be retained in the application. Since this question is not involved in the appeal, it is believed the initial ruling thereon should be made by the examiner.

The decision of the examiner is reversed.

Ban Threats of Patent Suits in Bad Faith

THE Federal Trade Commission has ordered Flynn and Emrich Company, Baltimore, manufacturer and seller of stokers and coal feeding mechanisms to discontinue the practice of threatening persons or firms with patent infringement or damage suits for the purpose of diverting the trade of competitors into its own channels, and without intention of actually bringing such suits.

Findings of the Commission show that a mechanically operated stoker made by the respondent was covered by letters patent, but that devices similar in design were being sold by competitors, and that attorneys informed the respondent they considered the company to have a good case and that its patents probably would be upheld by the courts.

The Commission found that representatives of the company were furnished copies of the patent papers as well as given permission to show them to prospective customers and to point out that certain features were embodied in the Flynn and Emrich stoker and were patented and that if any other manufacturer incorporated the same feature in its stoker, it was infringing this company's patents. The company also permitted its representatives to make known that a user of an infringed article could be made a party to a suit just the same as a manufacturer could.

In several instances Flynn and Emrich salesmen interviewed persons who had contracted to purchase the stoker of a competitor, the Perfection Grate and Stoker Company, of Springfield, Massachusetts, and warned such persons that they might get into trouble over patent rights, the Commission found.

During the period in which the respondents' salesmen were making these statements the company had not determined to bring any suit, the Commission found, and at the time the Commission's complaint was issued in March, 1929, the respondent had brought no suit.

These statements of the representatives were held by the Commission to be directly chargeable to the respondent company and to have been made in bad faith and without definite determination to bring suit for infringement or damages, and for the purpose of preventing a competitor from selling its products.

Claude's Neon Patents Upheld

FEDERAL Judge Frank J. Coleman recently handed down an opinion holding the American Neon Light Corporation and the Neon Tube Sign Corporation guilty of infringing the patents obtained by George Claude in 1913 and covering the neon light principle.

Claude's patents are now owned by Claude Neon Lights, Incorporated, which brought suit against the two concerns demanding a permanent injunction, an accounting of profits, and estimate of damage.

Judge Coleman, who sat without a jury, decided that only two officials of the American Neon Light Corporation took part in the infringement. They are Otto B. Schulhoff, president and chairman of the board of directors, and John W. White, secretary.

Judge Coleman exonerated William T. McGurk, Abraham E. Lefcourt, Louis Haas, Bertram A. Unga, and David Nicholsurg, directors of the American Neon Light Corporation. The complaint was permitted to remain against White, William J. Rose, J. A. Greene, and Eugene I. Doctor, who are said to have been the principals in the Neon Tube Sign Corporation and traded under that name. In addition Morris Jacobs, of Kane, Brooks & Co., brokers, was named.

By the decision of Judge Coleman an injunction obtained in 1928 is made permanent and Claude Neon Lights, Inc., may sue the individuals named.

Coal Saver Fraud

A COMPOUND that is alleged to make poor coal good and good coal better, is involved in an order of the Federal Trade Commission to F. L. Mennie of Omaha, Nebraska, trading as Mineral Coal Saver Company, Mennie Manufacturing Company, and M. and K. Manufacturing Company.

Besides ordering Mennie to cease advertising that his product, consisting principally of common salt, will make poor coal good and good coal better, the Commission prohibits such other presentations as the following: That such a compound prevents or removes soot; increases the heat from a given quantity of coal to any extent in British Thermal Units; gives 20 percent more heat with less coal; is carefully compounded under supervision of a chemist (unless and until such time as a qualified chemist is actually employed for this purpose); is a chemical mixture of proven worth or scientific merit (unless and until, after a comparative test of the use of the product with the non-use thereof, under otherwise identical conditions, its worth shall have been demonstrated scientifically); and that "modern science in such a compound has produced a sootless or smokeless treatment for coal."

Directions for use of "Mineral Coal Saver" say to dissolve one pound in six to twelve gallons of water, depending on the kind of coal, and apply by sprinkling.

Mennie's product, analyzed by government and civilian experts, shows for different samples slightly different compositions, as to about 10 percent; but common salt averaged about 90 percent in all tests.

Mennie testified that his formula called for 240 pounds of salt, half as much rock salt or fine salt, to which he added twelve pounds each of potassium chlorate and potassium permanganate and a small amount of coloring to "camouflage."

Coal, when treated with the "saver," was found to burn with a high yellowish crackling flame and to release one half to one and a half percent additional oxygen in the fire chamber so that there was additional combustion to that extent.

Expert chemists testified that this maximum increase in oxidation of one and one half percent would neither make poor coal good nor good coal better, nor do the other things as claimed by Mennie and prohibited in the order.

Inventors Called Saints

SPEAKING before the Executives Club of Chicago, Professor Harry A. Overstreet of the College of the City of New York recently made the following reference to inventors:

"We have the antiquated idea that the saint is a man so good you can't live with him. On the contrary, the inventor is the modern saint, the man whose inventive spirit enables him to give us machinery and ideas to make life as life ought to be."

BOOKS SELECTED BY THE EDITORS

AMERICAN DIESEL ENGINES—*By L. H. Morrison*

THIS is a comprehensive discussion of all present-day Diesel engines built in the United States, written in an interesting manner, and containing information of value to both the executive and the operating engineer. Among the topics covered are: relative costs of Diesel and steam plants; operation and adjustment of Diesel engines; and advantages of Diesel power for factory plants, excavators, central stations, etc. It also covers fuel and injection systems, lubrication, and engine output in a thorough manner. A much needed text.—$5.20 postpaid.

AVIGATION

By Harvey H. Holland, Capt. Air Corps, U. S. A.

BASED upon his experience as a transport pilot, airship pilot and free balloon pilot, as a member of the A.S.M.E. and the Society of American Military Engineers and by reason of his training as an airplane and balloon observer, the data given in this condensed little book of 272 pages is exceptional in its practical conclusions of the principles and methods of avigation practice. It is a textbook for student pilots and airmen preparatory to Department of Commerce examinations, as well as an authoritative reference for the seasoned pilot and airman.—$2.65 postpaid.

ZOOM—*By Capt. George R. White*

YOU will get more interesting sidelights from this book as to what to do and what not to do, than from any other source we know. Facts, incidents, impressions and knowledge of the simple mechanics, just the things one wants to know and ought to know, before starting to fly. The knowledge of meteorology shown here is practical experience translated into most understandable language. Young and old alike will read easily through the 182 pages and confess that they have learned a lot not contained in more formal treatises.—$1.65 postpaid.

ENGINEER'S VEST POCKET BOOK

By W. A. Thomas, Consulting Engineer

CLEAR and compact in arrangement, an almost incredible scope has been encompassed in this handy little book of 400 illustrations, 153 tables, 30 curves, with an index of 725 items. It is a most ready reference regardless of whatever branch of engineering one may specialize in. Durably bound in morocco grained leather, gilt edges, flexible.—$3.00 postpaid.

SHORT WAVES—*By Charles R. Leutz and Robert B. Gable*

CHARACTERIZED by the authors as "the first radio book devoted exclusively to short waves," this 384 page volume scans the whole science that has grown up within less than two decades. In 1917 the wavelength of 150 meters was considered "short." Today, research workers are taking a single meter apart in an attempt to use wavelengths measured in fractions. Long distance radio telephony and telegraphy, directional transmission, television, aircraft radio, medical and surgical applications of radio waves, all have flourished as the result of discoveries made in the past few years. This book treats them all in a manner comparatively free from technicalities, yet spreads before the reader a wealth of information on these vital phases of radio that would be difficult to obtain elsewhere. Not a "how-to-make-it" book, but one that will prove informative to everyone who is interested in radio development work.—$3.20 postpaid—*A. P. P.*

CHILDREN WHO RUN ON ALL FOURS—*By Aleš Hrdlička, Curator of Anthropology, U. S. National Museum*

TWO or three years ago, through the aid of the press, Dr. Hrdlička asked the public to co-operate with him in gathering records of infants who habitually run on all fours like little animals, instead of creeping or walking. The result exceeded all expectations: 387 mothers and fathers, mostly Americans of better-than-average stock, wrote him letters containing detailed descriptions and narratives, together with photographs of their children "caught in the act." These children are in no way subnormal; they assay distinctly above average both in health and mentality. The distinguished anthropologist has embodied these many letters, just as they were written, together with the photographs and a scientific analysis, in a 405-page book which is as truly a human document as a work of science. This "inheritance from the prehuman past," hitherto unrecognized, is now seen to be fairly common and Hrdlička has added a new proof of human evolution to the list of classic proofs.—$5.20 postpaid—*A. G. I.*

OUR ALTRUISTIC INDIVIDUALISM—*By C. E. Blanchard*

IF you want to understand a little better the psychology of our social system and to comprehend the real meaning of human conduct as viewed in sympathy with the underdog, read this book. The author prefers to make his points by stressing the unpromising, pessimistic viewpoint and thereby heighten his contrast with what may be called truly Utopian. The discussion is, penetrating, clear cut and without acrimony, though it is only fair to say it seems guided by a predilection to analyze the less hopeful side.—$3.20 postpaid.

COSMIC RELIGION—*By Albert Einstein*

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CONSISTING of six sections, naval, merchant shipping, naval reference, British and foreign ordnance, merchant shipping reference, and profiles and plans. The data given are complete and dependable and cover an extremely wide range. Photographs of the most modern cruisers are quite late and the whole forms the authoritative record which has been built upon 42 years of issue. Noted authorities in each line write or edit the text so it may well be termed a compendium of the best British information.—$10.20 postpaid.

FROM RECENT PUBLICATIONS

THE SCIENCE OF LIFE—*By H. G. Wells, Julian S. Huxley, and G. P. Wells*

WHAT a work! 1478 pages of compact type and illustrations—about 600,000 words, or 100,000 words longer than Mr. Wells's famous "Outline of History." The authors have spent the past five years writing these remarkable volumes.

In scope this work takes in everything that centers around the broad science of biology. There are 160 pages (a book in itself) on the human body and its workings. On other forms of life, another 160 pages. On evolution, 300 pages which cover every nook and cranny of the subject. The history of life on earth, 200 pages of pure fascination. Health and disease, microbes, vitamins and so on, 70 pages. Psychology, not the cut-and-dried kind but living psychology—the kind people are talking about—300 pages. Man's prehistory, 50 pages. But what is the use of sketchily citing the contents of these volumes? The real essence of this set of books is not what it covers but how it covers it—mainly with how much compelling interest. It will therefore suffice to say that it is a typical work, fully up to the Wells standard; for he has always known what people want to read and how to tell them so that they will keep on wanting to read what he says.

A biologist before he was a writer, Mr. Wells was educated at the Royal College of Science. Julian Huxley, grandson of the great Huxley of Darwin's day, is a well-known professor of zoology. G. P. Wells, son of the senior author, also is a biologist. Thus the work is more than sufficiently authentic. Unquestionably "The Science of Life" is destined to become one of the cornerstones of popular science.—$10.50 postpaid—*A. G. I.*

THE VINLAND VOYAGES
By Matthias Thordarson, Dir. Natl. Museum, Iceland

FROM translation of original sagas and later manuscripts in the Arna-Magnaean Collection in Copenhagen, an analysis is attempted of Leif Ericsson's discovery of the New England coast and the subsequent related events and adventures. Histories have always been extremely vague on this subject, so it is most interesting indeed to read a scholarly analysis of the ancient records. An introduction by Vilhjalmur Stefansson outlines the legends and records down to 1000 A.D. This is research series No. 18 of the American Geographical Society, Broadway and 156th Street, New York City, from whom this book may be obtained.—$2.00 postpaid.

WOOD, LUMBER AND TIMBERS
By Phillips A. Hayward

THE present work is a most complete treatise on wood structure; lumber—its manufacture and utilization; the identification of wood; industrial uses for woods; and the species of hardwoods and softwoods. One of the most valuable features of the large volume is the 164 tables which represent much patient research into the literature and trade practices of the industry and is not merely a statistical compilation of production. For example, we have a number of tables devoted to the influence of knots, proper thickness of lumber for various purposes, shipping weights, et cetera. There are 35 plates printed on coated paper and inserted, as well as 62 other illustrations and maps. Under each species treated is such information as the following: range, usual names, other appellations, description, uses, grading, rules, types and sizes, unit packages, shipping weights, service requirements, specifications, engineering data, names of associations (if any), publications and bibliographies. The book is an excellent example of specialized literature and will prove of great value to those in the trade as well as a handy reference book for use in all libraries.—$10.35 postpaid.—*A. A. H.*

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STORING UP TRIPLE RESERVES—*By Roger W. Babson*

ONE of the best selling little books that have recently appeared on the subject of choosing an occupation is "New Ways to Make Money" by this author. Now comes this title which is significant for its good common sense, keen analytical reasoning, and its broad vein of hopefulness and helpfulness. From an ethical basis and calm reasoning, no more convincing book has come to our notice: for even where one cannot entirely agree with the author, one must grant the inherent soundness of the development, and the entire freedom throughout from any controversial attitude. A sound, sane thesis by a most successful business man who "loves his fellow-men."—$2.15 postpaid.

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SCIENTIFIC AMERICAN PUBLISHING COMPANY
Formerly Munn & Co., Inc., 24-26 West 40th Street, New York

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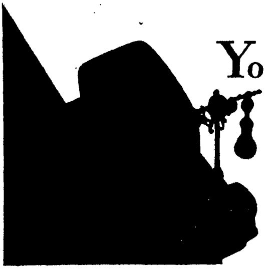
Why, he could no more escape the presence and the power of the printed word than he could evade eating or sleeping. The advertisements are a definite part of contemporary American life. Their messages are vital to daily existence. They have a definite association with the pocketbook, than which there is nothing more intimate and personal.

The important thing is not merely to "read the advertisements," but to read *all* of them. The one advertisement you "didn't see" may contain information you would have given a great deal to possess. . . . Certainly, it is as important to you to know that there is a new type of household appliance on the market, as to read that Congress will hold a special session!

●

"Friend, guide and counselor"—the advertisements in this magazine



You call it an *Automobile*

BUT-

we call it *apparatus* in Ethyl laboratories

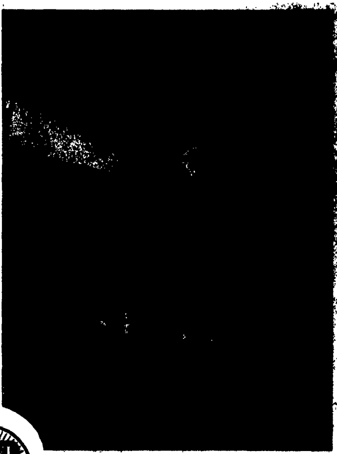
FROM the garage doors of the Ethyl Engineering Laboratory in Detroit—cars come and go. Stock cars, special cars; cars like the one you drive today and like the one you'll probably drive tomorrow. They are a part of the *apparatus* that engineers of the Ethyl Gasoline Corporation use in their everlasting search for fact.

During the past three years over 500 cars have been purchased, many of them worn out and destroyed by gruelling tests that tell the facts about motor fuel.

These tests prove that Ethyl Gasoline gives more power, that it takes better care of your car, that it does not "knock" and that it is admirably suited to the needs of *any* car sold today.

Tests prove that *any* good gasoline is made better by adding a few drops of Ethyl fluid; that this valuable fluid will control the combustion of *any* good gasoline so its power will be delivered in smoothly increasing pressure to the pistons, bringing out the best performance of any motor.

All Ethyl Gasoline is made from *good* gasoline. It all contains enough Ethyl fluid to *control combustion*. Try it yourself *from the pump that bears the Ethyl emblem*. You will like it. Ethyl Gasoline Corporation, Chrysler Building, New York City.



Taking the compression pressure of a stock model car with special head. 175 pounds compression is a much higher pressure than that of any car on the market, and this engine is operating satisfactorily on Ethyl Gasoline.

The active ingredient used in Ethyl fluid is lead.

ETHYL

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ETHYL GASOLINE

An Industry That Was Made-To-Order

Which Races Are Best? • • How Big is a Quantum?

22.MAY 1931

SCIENTIFIC AMERICAN

May • 1931

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HOW THE AVIATOR SEES A RAIN-BOW

HEN A BEARING GOES TO SEA

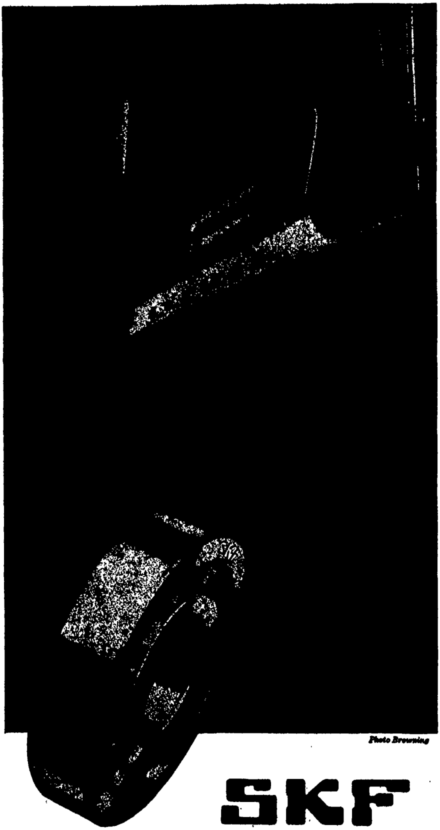


Photo Browning

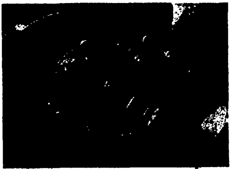
...there's nothing but PERFORMANCE that counts

HERE'S to a hail and hearty deep-water bearing that goes sailing over the Seven Seas and gets a nod of approval from salty engineers in every port on the globe. You know the bearing, too. It's SKF.

Ocean-going bearings simply can't fall down...not when they support the whirling propeller shaft...not when they take the thrust of the big screws that push tons of water astern...nor when pumps, fans and other auxiliary equipment depend upon them.

So when it comes to anti-friction bearings, marine engineers write SKF on the specification sheets as a matter of course. They can't afford to take a chance on performance. When a bearing goes to sea there's nothing but performance that counts...which is just as true of a bearing that stays ashore. SKF Industries, Inc., 40 East 34th St., New York, N. Y.

SKF
Ball and Roller Bearings



Propeller Thrust Block, SKF equipped, on the S. S. "Robur 4th." SKF Bearings are also used on auxiliary equipment of the S. S. "Leviathan" as well as on many other trans-Atlantic liners.

Consider the Lowly Match

An insignificant splinter of pine—strike—a light—flick—out it goes—dead

Yet this match represents an industrial empire. Forests, Mills, Mines, Railroads, Steamships, Laboratories, Banks and the Stock Market have been concerned with its making.

Nations have been financed by it. Billions of dollars are invested in it. Thousands of men and women depend upon it for their livelihood.

Have you ever thought of the far flung empire of which your business is a part?

Behind every business transaction there is Conquest, Victory, Romance, Human Strength and Human Brains.

But to understand the intricacies, to master each phase of your business and to be able to coordinate all its complex units, you must have knowledge and information.

That is the function of FORBES.

It gives you all the facts you need to know. Every line FORBES prints applies to you. You must have the vital news of all business to get the best out of your business.

Daily there are new developments, changes, trends. FORBES reports them for you.

It interviews the business leaders of the world and brings you their experiences and opinions.

It analyzes markets and gives you definite recommendations and forecasts.

It tells you how to increase sales, to cut overhead and eliminate wastes.

FORBES pictures the struggles and successes of outstanding men and firms for your benefit and inspiration.

It raises business from the realm of mere profit-making and helps you feel the romance, the thrill and the joy of men working together.

FORBES is more than a lot of printed pages between two covers. It is an organization of men who associate with men and serve men.

It is as live as life itself.

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To know FORBES is to use it, to trust it and to profit.

Our circulation records show the steady growth of our following. The A. B. C. recorded 54,310 circulation in 1927; 63,621 in 1928; 70,819 in 1929; 76,309 in 1930.

Consider the lowly match—a year's subscription is an insignificant investment, but it will pay you royal dividends. Fill in and mail coupon below for get-acquainted copy. If you are the advertiser of a product for business men, check coupon for data on the FORBES market.

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BUSINESS, FINANCE, BUSINESS OF LIFE

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TWO OUTSTANDING BOOKS

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by Paul R. Heyl, Physicist Bureau of Standards

THE MYSTERIOUS UNIVERSE
by Sir James Jeans, Cambridge University

BECAUSE these two books have so much in common and therefore ought to make appeal to the same type of thinking readers, we have bracketed them together and again urge all who wish to keep up with the most significant trends of thought in modern physics, astrophysics, cosmology and scientific-philosophic matters in general to acquire them. Each has been reviewed before—the Heyl book last year, the Jeans book earlier this year—and the reason we stress them so strongly now is not that they have failed to sell but that they have sold so well. Now that a little time has elapsed they are both seen to be outstanding books, their reception by scientific reviewers and other scientific men having been most enthusiastic. We have just reread both books ourselves, simply because we enjoyed them. Neither one is long on mere words but both are long on real content. They are not technical but on the other hand they are not light reading, being intended for intelligent thinkers. In dimensions and page length (160 pages each) the two are almost twins—a nice pair for your shelves or table.

The New Frontiers of Physics $2.15 postpaid
The Mysterious Universe $2.40 postpaid
Both books $4.25 postpaid

SCIENTIFIC AMERICAN

24 West 40th Street **New York, N. Y.**

SCIENTIFIC AMERICAN, May 1931, Vol. 144, No. 5 entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Scientific American Publishing Company, 24 West 40th Street, New York City. Copyrighted 1931 by Scientific American Publishing Company, Great Britain rights reserved. Subscription price $4.00 per year. Foreign $5.00.

SCIENTIFIC AMERICAN

Owned and published by Scientific American Publishing Company; Orson D. Munn, President; Louis S. Treadwell, Vice-President; John P. Davis, Treasurer; I. Sheldon Tilney, Secretary; all at 24 West 40th Street, New York, N. Y.

EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

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THIS MONTH'S COVER

When the horizon or some other obstruction does not intervene, the familiar rainbow becomes a full rain circle and, in cases where a secondary bow would form, a secondary circle will form also, as shown in our cloud-top cover painting. The shadow of the airship will fall in the center of the circle and the whole will be a striking spectacle. Generally the radius of the inner red spectral band is about 42 degrees; that of the red in the secondary bow about 50 degrees; but as stated in that final authority on all kinds of peculiar phenomena, "The Physics of the Air," by W. J. Humphreys, United States Weather Bureau meteorological physicist, "rainbows differ, among themselves, as one tree from another." Always, however, the red of the primary bow will be outside; that of the secondary bow inside.

Amateur Telescope Making

ALBERT G. INGALLS, *Editor*

THE Daily News continues to supply items in the science of astronomy from all corners of the world, and apparently this is leading many a handy person to desire to build his own telescope. At least so the continued sale of this unique book would seem to indicate. Every detail from where to get the materials through to the final testing is given fully and simply. $3.00 postpaid.

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By C. D. HODGMAN AND N. A. LANGE

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By FREDERICK KUHNE

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ACROSS THE EDITOR'S DESK

When we scheduled for publication in our March issue the article entitled "Companions in Depression," by Raymond B. Fosdick, we were uncertain as to its reception by our readers. The way in which it treated an all-important subject made it seem foreign to the pages of Scientific American, yet it was so concise, so thought-provoking, so thoroughly scientific, that we decided to publish it. That our decision was sound was immediately evident when the March issue reached our readers and we began to receive letters commending this particular article. We quote from one as an example: J. R. Edwards of Cincinnati, Ohio, writes: "For over 20 years I have been reading the Scientific American from cover to cover and I have never read a better scientific article. . . . Its logic carries so much conviction." We thank Mr. Edwards and many other readers for comments received, and promise them many more articles in the future that will be just as interesting and informative.

•

Looking ahead, we find another article on that inseparable pair—science and industry. It deals with new ideas in business and points out the indisputable fact that if a business or industry is to continue to exist and prosper, it must keep up with the times. This means that it must keep up with science, for it is science that supplies the ideas which open new fields and make possible the expansions and changes which spell good business. In this article, scheduled for publication in our June issue, the author draws a series of parallels that forcibly drive home his points and offers a vast field for thought regarding our economic future.

•

When our forefathers struck out from civilization and made their homes in what was then an untrodden wilderness, but is now criss-crossed with railroad tracks and concrete highways, their map-making facilities were of the crudest, but were sufficient unto the purpose. Now, however, with the advances made in transportation, the day of the surveyor's compass and chain has passed and instead we find the theodolite and the invar base tape; the topographic map has replaced simple route maps or sketches; triangulation has become the order of the day. The author of a comprehensive article on this subject states; "There are two important phases of triangulation; first, how is it done and, second, what is the practical value of the results obtained?" He then goes on to answer these self-imposed questions and the story that he unfolds is one which will give to the reader a better understanding of the science of map-making. A map, *per se*, is an object that commands immediate interest; an intimate knowledge of the background of map-making increases that interest many-fold.

•

The 12-month calendar, handed down from earlier times, has many inherently bad qualities; even opponents to calendar reform will admit this to be true. But what shall we do about it? Several business firms have adopted modified calendars for their own inter-office operations, and the fact that they retain them after trial seems to indicate that they hold merit. We are fortunate in obtaining from one of the foremost proponents of calendar reform, George Eastman, an article setting forth the problems encountered, and some of the attempts that have been made to solve them. This article, to appear in our June issue, will turn the discerning light of clear thinking on a subject that, because it affects directly each and every one of us, will command more and more attention as time goes on.

•

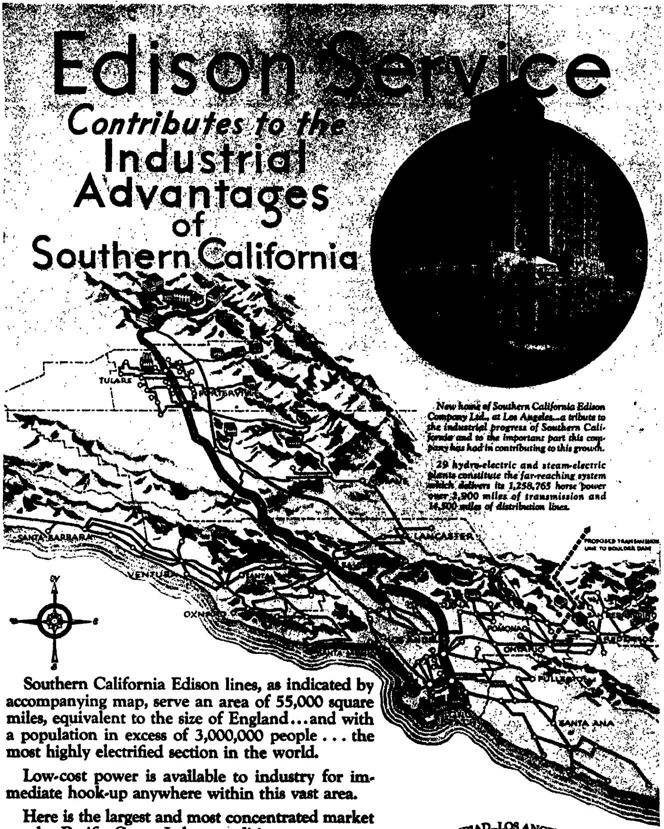
A short time ago, Henry Ford made the statement that the day of the small farmer is nearing an end, that soon all farms will be mechanized and be assimilated by large farm companies. The tendency seems to be that way, but few realize that gardening in some localities is already in the field of big business, with mechanical equipment that promotes efficiency and increases profits. This particular sort of progress means better and cheaper food for city-dwellers and greater prosperity for the gardener, and therefore the discussion of it in our June issue will interest the nation.

•

Probably the majority of us have a feeling of loathing for insects in general, yet it is well known that many of them are of great value to the human race. One of the latest examples of this value has been strikingly demonstrated in Australia, where the unwanted prickly pear has developed to a point where it has become an economic problem of large proportions. Land on which the prickly pear has obtained a foot-hold becomes valueless for grazing or agriculture and so some method of curbing its growth and spread becomes necessary. Enter the insect. By a selective process of experimentation it was found that certain insects would attack and destroy the prickly pear but have an antipathy toward plants of economic value. The experiments made, and the results obtained, will be found in an article to be published soon.

Orson D. Munn

Edison Service
Contributes to the Industrial Advantages of Southern California



New home of Southern California Edison Company Ltd., at Los Angeles...a tribute to the industrial progress of Southern California and to the important part this company has had in contributing to this growth.

29 hydro-electric and steam-electric plants constitute the far-reaching system which delivers its 1,258,765 horse power over 3,900 miles of transmission and 14,500 miles of distribution lines.

Southern California Edison lines, as indicated by accompanying map, serve an area of 55,000 square miles, equivalent to the size of England...and with a population in excess of 3,000,000 people . . . the most highly electrified section in the world.

Low-cost power is available to industry for immediate hook-up anywhere within this vast area.

Here is the largest and most concentrated market on the Pacific Coast. Labor conditions, transportation, building costs, raw material sources, climate... all factors combine to create here a most unusual opportunity for industry.

Address inquiries to Industrial Dept., Los Angeles Chamber of Commerce.

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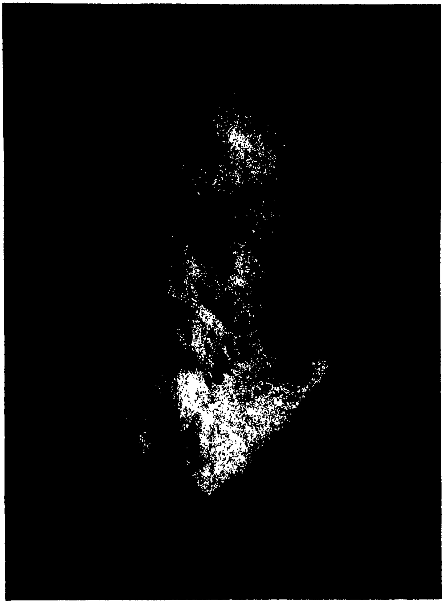
Edison

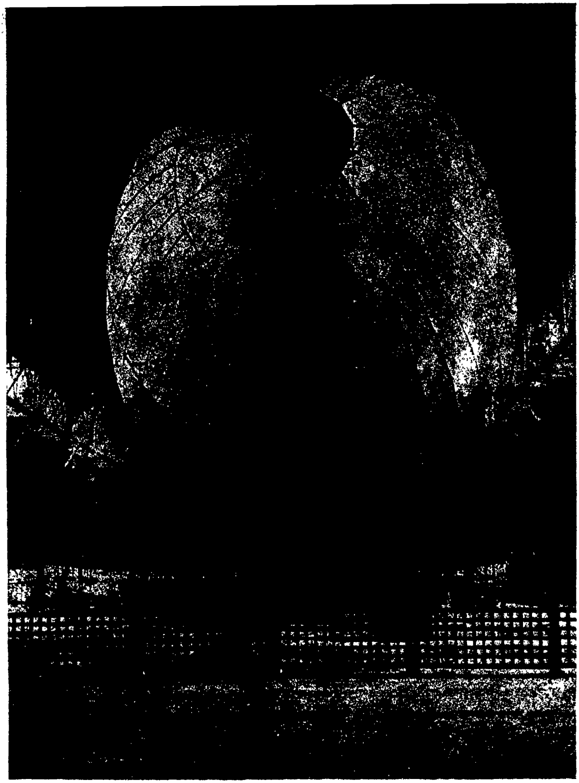
LOS ANGELES . . . . CALIFORNIA



PROFESSOR BAILEY WILLIS is the recognized dean of the science of seismology in America. After a career of 32 years in the United States Geological Survey and seven years as professor of geology at Leland Stanford University he still continues his lifetime activities with the vigor of youth, having recently covered 6000 miles in Africa, largely on foot.

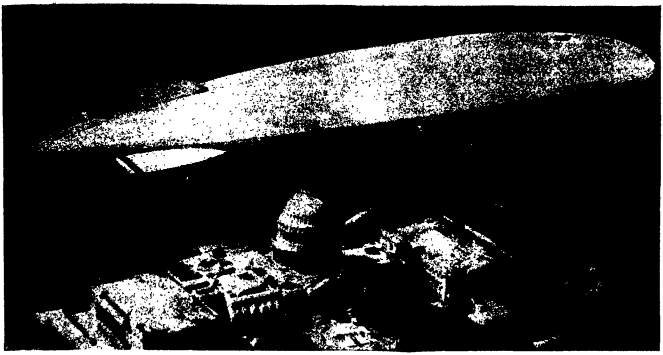
It was Professor Willis who in 1924 made the famous earthquake prediction which provoked a tempest in southern California. "A great shock may come soon," he wrote in the *Bulletin of the Seismological Society of America,* "or within a decade, or not till after more than a decade. But it will come." These few words from so eminent an authority on seismology sent earthquake insurance skyrocketing overnight and threatened to injure real estate development. However, Professor Willis remained unrepentant concerning his prediction and a party of men therefore interviewed Dr. Ray Lyman Wilbur, President of Stanford University (now Secretary of the Interior), asking that pressure be brought to bear in order that a recantation might be forthcoming. Dr. Wilbur is said to have listened patiently but refused to make the requested attempt to coerce the seismologist, adding simply that if Professor Willis had made such a statement it probably was true.

Two articles—"Growing Mountains" and "World Earthquake Belts"—by Professor Willis, were published respectively in the February and April numbers of the SCIENTIFIC AMERICAN for 1928.



MILLIONS OF HAND STITCHES ON ACRES OF CLOTH

A RECENT front-end view of the new Navy dirigible in its hangar-dock at Akron. Riggers hanging from the 200-foot high roof and others on top of 85-foot ladders are now covering the monster airship frame with closely woven, extra-ply, white cotton cloth, of which about seven acres will be needed, while a corps of girls, in another part of the factory, is stitching by hand the 12 gas cells which will take about 21 acres of cloth. The outer covering is tested for a pressure of 60 pounds per square inch, and the cell fabric is made airtight by a special "dope." Goldbeater's skins are not used.



An artist's conception of the Navy's new dirigible flying over the national Capitol

NAVY'S SUPER-AIRSHIP NEARS COMPLETION

THE experience of the Goodyear company in lighter-than-air craft dates back to 1911 when specialized machinery was installed for spreading rubber on cotton [illegible]oric. The first Goodyear balloon was [illegible]nufactured in the following year and [illegible] 1913 a Goodyear balloon took fi[illegible] place in the James Gordon Ber[illegible] , [illegible] of Paris.

Aeronautical activities at Goodyear were tremendously expanded with the World War. Kite balloons were wanted for aerial observation and the direction of artillery fire. Airships were wanted for coast defense, mine sweeping, and patrol.

Construction of the *RS-1*, first American-built semi-rigid airship, started in 1923, and in the same year came the acquiring of American rights for full rigid ships from the Luftschiffbau-Zeppelin, Friedrichshafen, Germany, largest constructors of Zeppelins in the world. Dr. Karl Arnstein, chief engineer of Luftschiffbau-Zeppelin and a dozen other expert engineers joined the organization at this time and the subsidiary, the Goodyear-Zeppelin Corporation, was organized.

The interest of the national congress in rigid airships was indicated in 1926 with the authorization of two ships of 6,500,000 cubic-feet capacity as part of a five-year aeronautical program. In March, 1927, a beginning appropriation of 200,000 dollars was made to start construction and in July of that year first place was awarded to Goodyear in an airship design competition held by the Navy and open to the world.

The 70th Congress in 1927 included the item of 8,000,000 dollars in the naval appropriation bill for the construction of two ships. Contract for these was awarded to Goodyear in October, 1928.

When the first of these sister ships, to be designated the *ZRS-4* and *ZRS-5*, takes the air this spring, it will be the largest dirigible in existence. In cubical content it will be equal to about twice the size of the *Graf Zeppelin*, and about 35 percent larger than the *R-100* and *R-101*, built in England. Compared with the United States Airship *Los Angeles*, it will be about two and a half times as large. The accompanying table shows the relative sizes and general characteristics.

Dirigible Characteristics

Name	*Los Angeles*	*Graf Zeppelin*	*ZRS-4*
Nominal gas volume, cu. ft.	2,470,000	3,708,000	6,500,000
Length over-all, ft.	658.3	776	785
Maximum diameter, ft.	90.7	100	132.9
Height over-all, ft.	104.4	113	146.5
Gross lift, lbs.	153,000	258,000	403,000
Useful lift, lbs.	60,000	?	182,000
Number of engines	5	5	8
Total horsepower	2,000	2,750	4,480
Maximum speed, miles per hour	73.1	80	83.8
Range without refueling at 50 knots cruising speed, land miles	4,000	6,125	10,580

The tendency of modern airship design is in the direction of a more curved profile, making the ship appear slightly shorter and fatter. The lead pencil shaped ship, which lent itself ideally to the necessities of mass production during war time, was partially reflected in the slenderness ratio of the *Graf Zeppelin* whose builders had to utilize the hangar facilities they had.

Consequently, the American *ZRS-4* will be only 15 feet longer than the *Graf Zeppelin* while having nearly twice the gas capacity. The American ship is, however, 34 feet greater in diameter, giving it an aspect ratio of 5.9, as against the 7.7 of the *Graf*. That is to say, the American ship will be only about six times as long as it is thick.

The *ZRS-4* is built on the triple-layer principle of Zeppelin-type ships, having (1) a rigid metal framework to withstand the major stresses from the loads carried, lifting gas forces, dynamic and aerodynamic forces; (2) gas cells within to retain the lifting gas; and (3) a taut fabric outer cover, doped and metalized, waterproofing it, protecting it against the elements, reflecting rather than absorbing heat, and offering a smooth flying surface.

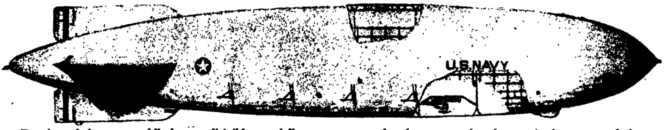
This arrangement has the advantage that one part may assist and to an extent replace another and is in contrast with the non-rigid airships, wherein a single layer of specially treated fabric holds the bag to shape only so long as there is sufficient pressure inside and must serve all of the above functions.

The framework of the ship is composed mainly of transverse rings con-

---

Text and photographs courtesy Goodyear-Zeppelin Corporation

nected by longitudinal girders, the latter extending from nose to tail. These so-called rings are, over most of the length of the ship, 36-sided polygons, with their corners connected by the longitudinal girders. Near the tail of the ship the number of sides reduces to 24. Diagonal wires form a network, bracing the outside panels described by the above structure, while another system of wires and cord nettings transfers the gas cell pressure to the framework.



Drawing of the new world's largest dirigible, partially cut away to show interior structure. At the top is the longitudinal passage for the crew, and at bottom is shown one of the airplanes in its interior "hangar." Four propellers are shown

The transverse or ring girders are of two types—main and intermediate. The main girders in the *ZRS-4* and *-5* constitute a new feature in airship construction. Whereas former designs required a great number of wires connecting all possible corners to maintain a stiff unit, the rings in the navy ships are built inherently strong, consisting of two outer annular rings connected by cross-girders, in zigzag fashion, to an inner annular ring, forming a triangle.

The main rings are spaced usually about 74 feet apart, the gas compartments being set between them. There are 12 gas cells in the *ZRS* ships, forming a bulkhead system similar to that in surface ships, since the loss of buoyancy in even two whole compartments in the ship does not seriously endanger the craft.

Again the ring girders are large enough to form corridors for crew members to climb entirely around the circumference of the ship, facilitating inspection and maintenance.

The longitudinal girders connect the transverse or ring girders and run from one end of the ship to the other, forming fore and aft ridges or ribs which are discernible from the outside of the completed ship.

Throughout most of the length of the ship there are three gangways or corridors, triangular in shape. One extends along the top center line of the ship. The other two are placed symmetrically in the lower part, about 45 degrees from the vertical. This arrangement is another departure from the past practice which employed a single corridor along the bottom of the ship, with a "cat walk" running from nose to tail.

The lifting gas in an airship expands and contracts with changes in altitude, temperature, and barometric pressure. While the degree of inflation in a helium ship is calculated for any given flight so that at the peak of expansion the helium will merely fill the cells completely, yet provision is always made in rigid airships for immediate release of any surplus expansion that might come under unusual conditions.

The various cells of the *ZRS-4* meet this by over-pressure valves. Since the gas is lighter than air, these are located in the gangway at the top of the ship. In the largest cells there are as many as four of these valves spaced along the top.

The valves open automatically under pressure to release any surplus. In addition, however, each cell has one valve which may be mechanically operated from the control car, so that the ship commander may immediately release gas in all compartments if operating conditions make this desirable.

Location of the valves in the top gangway makes it easier for them to be inspected and kept in perfect working order than in any airship previously built.

THE control surfaces, by which the ship is steered—either as to direction or altitude, are arranged in pairs near the stern of the ship. The main fixed section gives stability to the ship and the hinged after-sections or rudders give it altitude and direction control.

The fins, or fixed sections, are of triangular cross-section—rigid enough in themselves so that little external bracing is required. The rudders are controlled by cables leading to the control car or may be steered by emergency helms in the lower fin. Exertion at the wheels in handling so huge a ship is reduced by providing each rudder with balancing vanes.

The control car is placed forward, projecting below the streamline of the lower half and is built as an integral part of the structure. Here the commander and his staff are stationed, directing operations. The control car contains all of the latest devices known for efficient navigation and control. The car has been made only large enough comfortably to take care of only these operations, thereby reducing the air resistance to a minimum. The radio cabin and commanding officer's quarters are placed directly over the car inside the hull.

Near the middle of the ship and along each side gangway are located a number of rooms for officers and crew. Each sleeping room is provided with four comfortable berths. A large galley with ample cooking facilities, mess rooms, and toilets make up complete and comfortable living compartments for the men while in the air.

The use of helium as a lifting gas has made possible other improvements in the new Navy dirigibles. The use of hydrogen gas, inflammable and under some conditions explosive, in ships built outside the United States has necessitated that power plants be placed outside the ship in cars attached by outriggers so as to supply ample ventilation and prevent the possibility of a spark from the motors reaching the hydrogen. This arrangement, even when the size of the cars was reduced to a minimum, still contributes considerably to the air resistance of the ship and hence affects the speed and makes cramped working conditions for the engine crews.

The American ships, using the non-inflammable helium gas will house all the motors within the ship's hull with only the propellers extending outside the ship and will have a roomy engine room instead of a cramped car for the crew built along the gangways. There are four engine rooms on each side of the airship.

Another important change is the use of bevel gears at the outboard ends of the rigid drive-shafts, making it possible to use the propellers, not only for thrust in a fore or aft direction (the engines themselves being reversible), but also in a vertical direction, by tilting the propeller axes through 90 degrees. This feature of tilting propellers will be of great importance in starting and landing maneuvers. It will also permit carrying a greater load and avoid the loss of lifting gas when the ship has to be landed against surplus lift.

When liquid fuel is used in an airship engine, a definite loss of weight is experienced from hour to hour as fuel is consumed. In past practice this has required the release of a corresponding quantity of the lifting gas. In the *Graf Zeppelin* this difficulty was met by the ingenious device of using a gas fuel, the well known blau gas, which has approximately the same weight as air, so that fuel consumption does not affect the ship's weight or lift. The United States Navy Department met the difficulty in still another way - namely, by installing condensers on the motors at the exhaust, liquefying the combustion vapors.

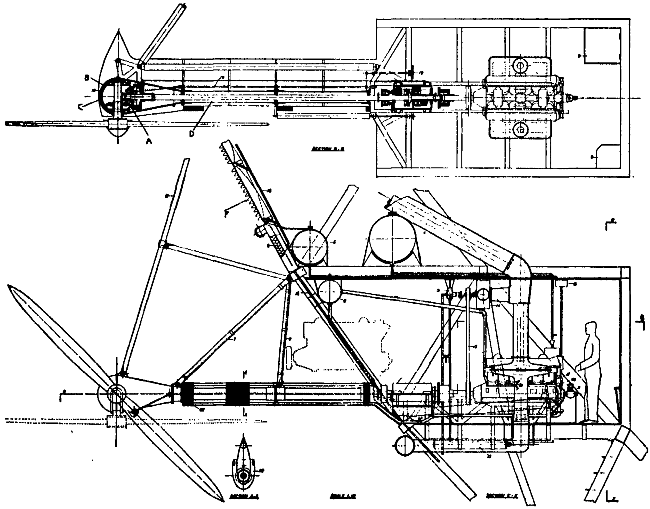
Due to the oxygen taken from the air in the combustion of gasoline, the exhaust gas contains water vapor in greater quantity than there was fuel burned. Therefore the consumption of fuel does not lighten the ship but builds up a supply of water ballast (this being also a highly useful feature in flying the ship) and maintains constant equilibrium.

The equipment now used by the Navy consists of a system of connected tubes exposed to the airstream and installed between the engine car and hull. This device has proved satisfactory as to thermal effect, but involves considerable parasite resistance. In the *ZRS-4* the possibility of eliminating much of this drag by locating the condensers along the surface of the hull has been investigated. The system as designed is equipped with a counterflow pre-cooler that takes the exhaust gases directly from the engines and drops their temperature about 80 percent. After taking up the heat, the air used as a cooling medium is piped away and used for heating the control car and quarters.

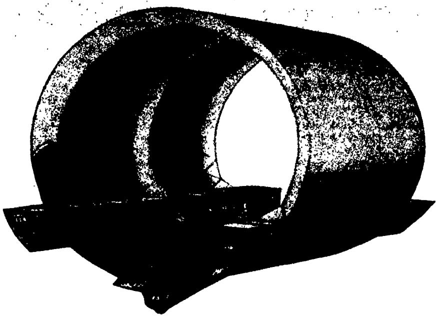
FROM the pre-coolers the gases pass into condensers. These are large, metallic panels which extend from the engines up to the sides of the ship. The outer surface is ribbed longitudinally and projects into the airstream so as to provide the maximum cooling effect with a minimum of resistance. Water separators are located at the bottom of the condensers, and the recovered water is piped from them to ballast bags along the side gangways of the ship.

A novel feature of the design of the Navy airships is the provision made for the storage of five completely assembled airplanes. A storage compartment, about 75 feet long by 60 feet wide, is located about one third of the ship's length from the bow, (between the crew's quarters). Collapsible doors in the bottom of the ship cover a T-shaped opening through which a trapeze with an airplane attached can be hoisted or lowered. The airplanes may attach or detach themselves from the trapeze during flight. Such a possibility increases the scouting value of an airship and aids her in warding off an attack.

Too much emphasis cannot be given to the structural strength of these ships, which is considerably in excess of that found in previous ships. Sufficient strength has been provided to meet such conditions as (a) violent maneuvers of the rudders, vertical and horizontal, both alone and in combination; (b) flying at excessive angles of pitch



One of the eight power plants and its swiveling propeller. Directly reversible engines are installed in separate engine rooms inside the hull and connected through rigid driveshafts and bevel gears (A) to the propellers which can be used for forward and reverse drive and, by tilting their axes 90 degrees, also for vertical thrust. The swiveling device is in an inner spherical case (B) inside an outer case (C) which is rigidly attached to the hull by a braced outrigger (D). The inner case can be turned by a worm driven by rod (19) from the engine room and the case and propeller are held in any position by a clutch. Longitudinally ribbed condensers of the water recovery system are at (F); water separators at (6)



Drawing to show the side longitudinal passages which the crew may use in going from one end of the ship to the other, and the control car below in front

due either to surplus buoyancy or to using the maximum available dynamic lift; (c) ship flying at full speed into a perpendicular gust region having a speed of 60 feet per second and a sharp border line.

The ship may still maintain progress if several engines should fail. Moreover, the ship may keep in the air by use of its dynamic lift, which results from flying her at a slight angle of pitch, to compensate for the extreme case of losing more lifting gas through large ruptures in the cells than can be compensated by jettisoning ballast.

THE fire risk has been reduced to a minimum through the use of the inert helium gas. The possibility of a gasoline fire is no greater than in an automobile. In fact, fire usually results only from a fuel tank ruptured in a collision—a remote possibility in an airship. Precautions are taken, however; the engine rooms have fireproof walls and elaborate fire-fighting systems; ventilation of the entire ship prevents the accumulation of any possible gasoline vapors; gas-tight electrical connections prevent the ignition of any local fumes.

There need be no fear of lightning—contrary to general opinion. Records show but two ships having been fired in this manner, and had they not been inflated with the inflammable hydrogen, even these would not necessarily have been lost.

Any damage to the hull due to a direct hit by lightning has been proved to be remarkably small and localized; this is due to the fact that every metal part is bonded to another, and the entire structure acts as a Faraday cage, rapidly dissipating a lightning charge.

Finally, there is the feature of accessibility, which is really one of safety. There is not a place in the ship which cannot be reached even while the ship is in flight. Thus inspection and repair may be carried out at any time, preventing minor damage from growing serious.

The structural design of the navy ships may be easily adapted to a commercial ship, one for carrying passengers and mail over-seas.

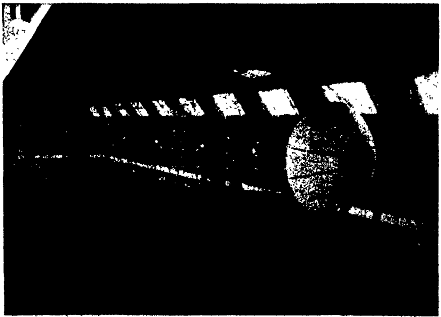
Here again the advantage of a helium-inflated ship presents itself. In previous passenger-carrying rigid airships, the presence of hydrogen practically demanded that the accommodations be placed outside the main hull structure. On the other hand, air resistance consideration necessitated keeping all protruding structures as small as possible. More or less cramped cabins was the result.

In a ship of the general dimensions of the *ZRS-4* and *-5*, accommodations may be built in comfortably providing for up to 100 passengers, according to the weight of fuel required for any certain route.

In the case of a 100-passenger ship the following dimensions are interesting: a total deck area of 12,000 square feet, of which each state-room (for two persons) uses an average of over 70 square feet; promenade decks and corridors have a total length of about 900 feet and an average width of five feet, while about 3500 square feet are used for public compartments. Promenades, lounges, dining salon, and smoking rooms are not dreams, but may soon be actualities.

Spacious compartments, the lack of noise and odors and sea sickness, speed of travel over the oceans greater than is possible to any surface craft—these are some of the advantages the airship has in store for travelers.

ITS contribution to overseas transportation will not be in competition to the surface carriers but supplementary to them—for that proportion of passengers and merchandise to whom higher speed is essential. It will do this without subtraction of business from existing carriers, for all history has shown that speed of travel means volume of travel. Surface lines and air lines will alike be beneficiaries as this new vehicle takes its place in the field of transport, applying in the international field what America has long learned nationally—namely, that better communication means better understanding, has vast economic advantages, and is equally impressive in the field of human relations.



After the frame was completed, the next job was that of covering it with a special cloth which is later to be "doped" and painted with metallic paint

OUR POINT OF VIEW

France and Italy Agree

THE differences between France and Italy relative to naval claims having been the cause of much dissension and suspicion on the continent since the London Conference, the recent Franco-Italian naval accord is a welcome sign-post pointing the way to peace. And while, in a sense, it is the rounding out of the three-power London Treaty into a five-power one, there are certain significant differences that will bear clarification.

The London Treaty set maximum submarine tonnage at 52,700, provided for a reduction of cruisers and destroyers, suspended construction of armored cruisers, and forbade transfer of tonnage between submarines and surface vessels. France's obstinacy won for her advantages in all these features. Under the Paris-Rome agreement, France is given 81,900 tons of submarines; she is allowed to maintain her present tonnage in cruisers and destroyers by replacing old vessels; she can build two armored cruisers of 23,333 tons each (and so can Italy); and she can utilize for surface vessels the difference of 15,000 tons between the 97,000 tons she demanded at the London Conference and the actual figure of 81,900 tons she accepted.

Final acceptance of this new agreement, not only by the two most concerned but also by the three signatories of the London Treaty—England, Japan, and the United States—lessens greatly the tension under which the world has been laboring for some time; the flame under the continental war caldron dies down somewhat and the war brew boils less vigorously. Some may say that France got more than her share; nevertheless the agreement has proved acceptable to the five naval powers, and we now know where we stand. If only Americans were not so apathetic regarding naval affairs, we could now proceed with a proper naval program which would give us our Treaty Navy by 1936. Unfortunately we seem to have lapsed from apathy into a coma.

Cynics Notwithstanding

IN these days one frequently—too frequently—hears of "jerry" builders and "gyp" contractors who skimp and scamp on materials and labor; and it is the custom for the modern cynic to contrast such reprehensible building methods with the solid, honest workmanship of the "good old days," those times before the art of skimping and scamping had even been thought of—usually, of course, with the added implication that in these modern times of sophistication, honesty has undergone a sad change for the worse. Therefore some recent revelations concerning skimping and scamping in a famous 15-16th Century structure, St. George's Chapel, where England's later kings are buried, as described by the Dean of Windsor before the Royal Society of Arts, may prove illuminating.

It appears that some cracks previously concealed by plaster recently indicated the need of restoring a part of the chapel. This work from the outset revealed a condition little short of astounding. The great stone ceiling vault of the edifice had been supported largely on brackets or "springers" attached to the walls, a construction which is safe if built with care. But as the Dean of Windsor says, "the builders took such chances and scamped their work so flagrantly that the brackets were not even bonded into the walls at all" and, he continues, "the architects have pointed out that there was consequently no scientific reason why the vaulting stood in its place. That it did not crash was an instance of the way in which buildings sometimes 'stick'—that is the only miracle which kept the vaulting in its place."

It further appears that one main wall of the structure had moved seven inches, though the foundations of the chapel supposedly rested on solid rock. An investigation revealed that while one of the walls was thus bedded, the excavation for the other had been carried down only within 18 inches of the rock and stopped in clay. This of course had gradually let the heavy walls down, allowing hundreds of tons of rock in the ceiling vault to sag 11 inches. St. George's was no place to venture into, but no one knew of the imminent danger and so all were blissfully happy.

Safety in Construction

NOT so many years ago when any large building was in course of construction, people used to say that a workman would be killed for each floor of the structure. No one knows how this peculiar form of fatalism originated but, strange to say, it persists even now to some extent.

Some time ago a statement gained wide currency that more than a hundred workmen were killed in the construction work on the Empire State Building which is described on another page of this issue. Actually, the records show the deaths of only five men; and only one of these five was entirely blameless in his own death. This man was sawing a plank when the opposite end was hit by a truck. Of the other four, one ran into a blast area, a second stepped off a scaffold, a third fell down an elevator shaft, and the fourth leaned into a shaft and was struck by an ascending hoist.

It is ridiculous to put any stock in tales of hundreds being killed on such jobs. At such a tremendous price in human lives, progress would indeed be but a great conceit of man. Happily, however, few lives are ever lost on large jobs—or small—because business and industry are making every effort to make carelessness an obsolete word and are helping the campaign by utilizing all manner of precautions.

Evolution

AFTER an interim during which it suspended publication due to early financial struggles, our contemporary, *Evolution*, now reappears and we gladly welcome it once more to the family of scientific journals. In all the world with its 23,000 scientific periodicals this, as far as we know, is the only one devoted wholly to the spread of information concerning evolution and the refutation of the silly arguments daily dinned into the ears of the millions by the well-organized anti-evolutionists.

Among our own readers we have discovered comparatively little interest in the purely controversial aspects of evolution, a fact which we interpret as evidence that our readers accept the basic principle as established and undebatable. The articles which we have published therefore have concerned only particular phases of evolution, not arguing the elementary fact of it at all. Doubtless, however, there is room for a specialized journal like *Evolution* which seeks in a rather lively manner to demonstrate to a wider audience of less well informed general readers the fact of evolution and refute the wordy opposition. The journal now carries the moral backing of a number of eminent men of science, among whom are two of our own Corresponding Editors, Professor Elihu Thomson and Professor William K. Gregory. Such names may be taken for what they are worth—and they are worth much.

INCANDESCENT REFRIGERATORS

By HENRY NORRIS RUSSELL, Ph. D.

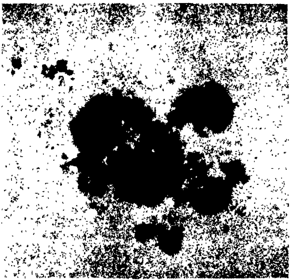
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

FOR many years it has been recognized that sunspots were cooler than the rest of the sun's surface. The evidence is conclusive and varied. The spots are darker than the photosphere —though by no means black, as is conspicuous when Mercury in transit across the sun's disk can be compared with them. At such a time it is also obvious that the light which comes from the spots is not merely duller but also redder than that from the rest of the solar surface, and this affords an independent proof of lower temperature. Finally and most decisive of all are the dif- s between the spectra of spots and of the disk. Some lines e weakened in the spot spectrum, many are strengthened, and many more appear in the spots which do not show at all in the light from the disk.

THE investigations of Hale and his colleagues at Mount Wilson about 25 years ago showed that the lines which are weakened in the spot-spectrum can be produced in the laboratory only at high temperatures or by the more violent excitation of the electric spark. Those which are stronger in the spots show just the opposite behavior, being relatively strongest in terrestrial sources when the vapor is as cool as is consistent with its being luminous. Some of the lines which appear only in the spots are of this sort but the majority are due to absorption, not by free atoms but by the molecules of chemical compounds which are evidently decomposed at the higher temperatures prevailing over the photosphere at large.

This cumulative evidence settled once for all that the spots are considerably cooler than their surroundings. But how much cooler? This proved a harder question to answer—as questions demanding a numerical answer almost always are—and a decisive solution has come only recently.

Pettit and Nicholson, working with the great tower telescope at Mount Wilson and thus having at their disposal an image of the sun 16 inches in diameter, and applying to this one of their delicate vacuum thermocouples, have measured the energy of the radiation from a small area in the center of a spot for various wavelengths in the spectrum and compared it with that from a corresponding area of the undisturbed disk. Their measures, which are numerous and consistent, show that at the violet end of the spectrum a spot gives out less than 30 percent as much light as the disk. In the red the proportion rises above 40 percent, and in the invisible infra-red it increases slowly to 80 percent. Averaging all together the total heat radiation from the spot is found to be 47 percent of that from an equal area of the photosphere, a result checked by direct observation without the intervention of the spectroscope.


Courtesy of Yerkes Observatory

A great group of sunspots. Diameter 250,000 miles. Though really hotter than the electric furnace, a sunspot is relatively cooler than the sun's surface

Part of this radiation comes from a scattering of sunlight by the air above the mountain. Measures on the sky just outside the sun's limb showed that allowance for this would reduce the real radiation from the spot to 40 percent of that from the disk.

After this correction the measurements, both of the total radiation and of its distribution among the different wavelengths, lead to accordant values of the spot temperature, 4750 degrees K.—measured on the Centigrade scale from the absolute zero. This is about a thousand degrees higher than even the most powerful electric furnace can reach, so that it seems pretty queer to call the sunspots "cool." But the temperature of the sun's undisturbed surface, measured in the same fashion, comes out 5950 degrees K., so that the spots are 1200 degrees cooler than their environment.

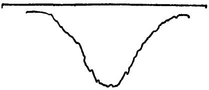
These are what are called "effective temperatures" and represent a sort of average of the temperatures of the various layers in the solar atmosphere down to the depth at which its increasing opacity prevents us from seeing farther. At a high level the actual temperature is doubtless lower than the values given above—perhaps by as much as 800 degrees. At the lowest depth to which we can see it may be 1500 degrees higher, but in both cases the temperature in the spot will be lower than elsewhere in about the same proportion. Sunspots may therefore be regarded as vast refrigerators, cooling the material of which they are composed by almost 2000 degrees Fahrenheit over a region thousands of miles in diameter and keeping it cool for weeks on end.

THE cause of this cooling is not far to seek. Hale's classical observations show that the spots are great whirlpools—vortices—in the sun's atmosphere. Evershed has shown that all around the perimeter of the spot the gases are moving outward from it at a speed which reaches a mile per second in the lower levels of the atmosphere. Hence the vortical motion is upward and outward—the exact opposite of that of water running out of a wash basin. The ascending column of gas must be forced to expand greatly, and forced expansion will cool any ordinary gas. Of course it comes from hot regions below the visible surface. Whether after it has ascended and expanded it will be cooler than the surrounding gas at the level it reaches, depends on the rate at which the temperature changes with depth in normal regions. This latter rate depends upon the way in which the flood of heat from the deep interior escapes to the visible surface and thence into space, and it can now be calculated. It is then found that the gases in an ascending vortex will indeed be cooled below the temperature of the surroundings. The latest calculations by Professor Milne show that an ascent of not more than 30 miles would account for even more cooling than occurs in the greatest spots.

The reasoning on which this conclusion is based appears to be very strong, but the results are, to say the least, perplexing. Sunspots are thousands of miles in diameter—often ten times this—and it is quite incredible that they can be less than a hundred miles deep. Yet if the material which streams out of them [illegible] a depth of thousands of miles, why is it not much more cool by expansion than the observations indicate? Another and even more serious difficulty arises. To keep any kind of refrigerating engine at work requires the steady expenditure of power. It is one of the most fundamental principles of physics that "work can never be obtained from any mass of matter by cooling it below the temperature of the coolest part of its surroundings." To produce such an effect work must be *done on* the cooled material. Thi [illegible] t takes power to keep an electric refrigerator running, as everyone knows. Where does the power come from to run the enormous solar refrigerators which we see in spots?

THE first rational answer to this question, and a very convincing one, was given a few months ago by the brilliant young German astrophysicist Unsöld. To understand it we must consider more fully what happens in an ascending column of gas. The statements which have already been made refer to a gas which has no stores of energy within it except the energy of motion of its molecules. If a mass of such gas should be forcibly raised from deep in the sun's atmosphere to a higher level it would expand till its pressure matched that at the new level, pushing aside the surrounding atmosphere and doing work at the expense of its own internal energy, so that it would become cooler. When it had done this it would be cooler than the surrounding medium and therefore denser (since the pressure was the same and we are dealing with gas of the same composition throughout). Being denser than its surroundings it would immediately start to sink back to its original level.

But now suppose that the gas in its initial hot and dense condition at the deeper level contains stores of latent—apparently concealed—energy of some sort. It might, for example, consist of two elements like hydrogen and oxygen, ready to combine but prevented from doing so at a great heat. As it rose and the pressure and temperature fell the combination might begin. This would liberate an additional store of "sensible" heat, so that when it reached the higher level a mass of gas of this sort would be considerably hotter than in the case previously described. If the latent heat thus liberated were great enough the ascending gas might even be hotter than its surroundings. If this happened it would also be lighter and would continue to rise. Other masses of gas from the lower level would follow it in a continuous stream, and a great ascending current of gas would be formed and keep on indefinitely until the available energy-containing material was exhausted, or perhaps until some external disturbance stopped the stream.



Courtesy *The Astrophysical Journal*

Curve of temperature taken across a sunspot by means of a thermocouple, by Pettit and Nicholson

Now the temperature inside the sun's photosphere is far too high to permit any chemical combinations; but just because it is high it encourages the more drastic process of ionization—the separation of electrons from atoms. The most abundant element in the sun's outer layers is known to be hydrogen. This is rather hard to ionize and, at the visible surface and even a little below, the proportion of ionized atoms is very small. But Unsöld's calculations show that a thousand miles or so below the photosphere where the temperature is about 15,000 degrees (if the gas is largely hydrogen) almost all the hydrogen atoms are ionized. If a mass of gas were to rise from this level to the surface the re-combination of the hydrogen nuclei (protons) and the electrons would liberate a great amount of heat—more than enough to heat the rising column and keep an ascending current running.

A little below the photosphere the hydrogen would be practically all neutral, and the heat-producing process would be turned off; but the ascending column of gas would persist by its own momentum, still rising but cooling by expansion in the last stages of its way, so that it would reach the photosphere as a cold current to spread out in all directions along the surface and use up the last of its energy in pushing out the surrounding gases.

Here, then, we have the long sought source of power to operate the sunspot "refrigerating machines." They appear as real heat engines, burning fuel composed of electrons and protons and discharging the waste gas—hydrogen resulting from the combustion of the two—at the top of the chimney-like vortex of the spot.

THE rotary motion is a by-product free to arise if there were the least initial tendency of the sort—as we see in wash basins, dust whirls in the air, and on a larger scale in tornadoes.

Many details of course remain to be cleaned up—what additional effect is produced by the combination of elec- [illegible] s and partially stripped atoms of the metals or of gases like oxygen, what starts and stops the motion, and the like—but a great advance has certainly been made.

One long-standing puzzle is immediately solved. The [illegible] sunspots big and little appear to be nearly the same. This used to be perplexing but in a rising current such as Unsöld discusses, the temperature would reach equality with that of the surroundings at a definite level at which the ionization of the hydrogen had become small, and the cooling at the surface would correspond to ascent from this level and hence be always about the same. Unsöld's figures indicate that this level would be only a little below the photosphere and not far from the depth suggested by Milne (which, by the way, would be increased from 30 to some 300 miles if the atmosphere is composed largely of hydrogen instead of heavy metallic vapors as he supposes). There is therefore good reason to accept Milne's conclusion that the cool part of the sunspot is at most a few hundred miles deep and therefore very thin compared with its diameter, "like a penny" as he suggests. Below this level the ascending currents presumably exist but if we could study them 500 miles deeper down we would find the spots hot and not cold.—*Princeton University Observatory.*

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Editor, Scientific American:

I much regret that, owing to an error in the preliminary carbon copy of the paper on the mass of Pluto, which Dr. Nicholson generously put at my disposal, one of the statements in my recent article [February, page 90.—Editor] *failed to report his final conclusions.*

If the earlier observation of Lalande is disregarded, the remaining observations of Neptune are insufficient for any precise determination of the mass of Pluto. If Lalande's observation is included, Dr. Nicholson's value is as stated. A different estimate of the accuracy of this early observation would lead to a different value of the probable error of the final result.

—Henry Norris Russell

BELLS

By ALBERT A. HOPKINS

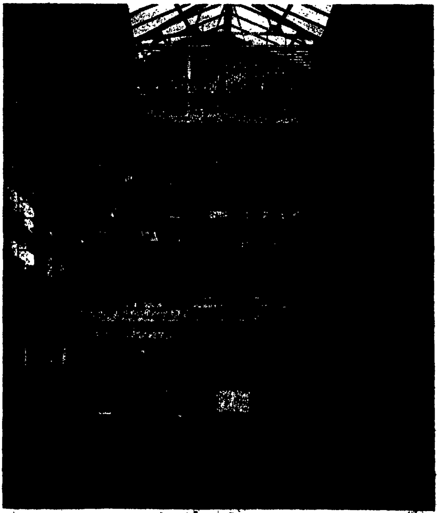
BELLS have a peculiar charm, like the organ, for most people. Formerly the best place to hear them was in the Low Countries, Belgium and Holland, but now New York City can claim the finest set of bells in the world. The Riverside Church, overlooking the Hudson River, has a carillon of 72 bells. Fifty-three bells were removed from the Park Avenue Baptist Church and 19 more have been recently cast in England. All are now in place and the formal dedication took place February 8, 1931. This largest of carillons is a memorial to Laura Spelman Rockefeller, mother of J. D. Rockefeller, Jr.

There is probably nothing which requires more patient skill and craftsmanship than the founding and finishing of a bell. Strange to say it is the small bell which is the most troublesome. Sometimes twelve casts may be made before a small bell with a true tone is secured. The large bells are made by exact formulas and there is no guesswork. Bells do not improve with age, neither do they retrograde.

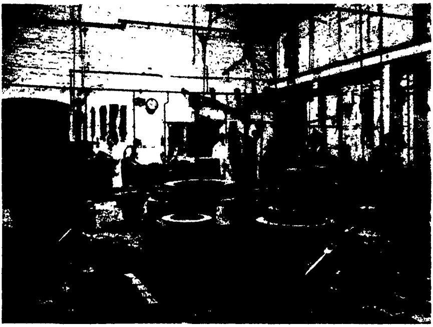
FROM olden to modern times the number of bells in bell towers was increased from four (we derive the word "carillon" from the Latin *quadrilionem*) to a considerable number, but the name remained unchanged. By "carillon" we now understand a set of bells of the finest musical quality and tuning. Twenty-three bells are the minimum and 72 bells the maximum. The bells are usually sounded with the aid of "claviers" arranged somewhat after the manner of the ivory keys in the console of an organ; they take the form of light wooden levers. These levers are attached by means of wires and cranks to the clappers which strike the bell on the inside surface at a point near its largest diameter; the travel of the clapper is about one inch, which is sufficient to bring out the full volume of sound required for carillon playing, while still allowing the delicate touch necessary to enable a single operator to manipulate so many bells. Pedals are attached to the levers connected with the heavier bells, so that these can be played by foot or hand. This enables the player to strike them more forcibly than would be possible with the hand levers, and it also allows him to execute the more intricate passages of music by leaving his hands free for the rapid manipulation of the levers connected to the smaller bells, playing the bass accompaniment with his feet. On a large carillon, mechanical devices assist the player; the so-called "deep-end," up to 24 bells, can also be played from the remote organ console. The player of a carillon is termed a "carillonneur" or "bell organist" and is a person of musical ability who has become expert in mastering the capabilities of the huge instrument.

In Croydon, England, is located the world-famous bell foundry of Gillett and Johnston, Ltd. Many of the artisans are descended from families of bell founders and their skill is most remarkable. On the molding floor of the plant in the charming Surrey suburb of London, the first thing that draws attention is what looks like a huge bell of sand. This is one of the cores which is formed to the exact shape of the inside of the finished bell. Over this fits a cast-iron case, also bell-shaped, and the molten metal is poured between the exterior of the core and the interior of the case to form the bell.

The core is built up on a brick, bell-shaped foundation which is erected on an iron plate fitted with lugs for hoisting. Upon this foundation sand and loam are applied and scraped smooth with a revolving template called a "strickle" board which gives the proper contour of the inside of the bell. The core has to be dried several times in an oven. The shaping and drying processes may take two or three days for a small bell or two or three weeks for a large one. If the hot metal should strike wet sand there would be an explosion and the casting would be ruined.



A carillon of 49 bells for a war memorial at Wellington, New Zealand. The carillon bells are hung in steel cages. The larger bells are often placed below the operating room. The console has claviers (handles) and pedals for large bells

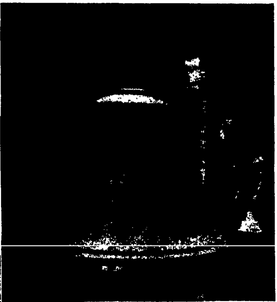


The final operation on the core is to cover it with black lead (plumbago) to give smoothness to the casting.

THE cast-iron case is solid for the small and medium sized bells, but built up in sections bolted together for the largest bells. The case is first turned mouth upwards and lined with a layer of damp sand two or three inches thick; this layer also is shaped with a revolving template or "strickle" board to give the exact shape of the outside of the bell. When completed to shape and before final drying, any inscription or ornamentation is provided for by stamping the figures or design into the still soft sand. This requires considerable skill to ensure clean cut, evenly spaced lettering in perfect alignment. To facilitate handling and turning over, the case is fitted with trunnions extending beyond the rim; these form pivots when suspended by two chains. The lining of the case also is dried in special ovens several times while being made, between each layer or coating of sand. When entirely dry the surface of the sand in the case also is coated with plumbago to give a smooth surface to the finished bell.

In the case of a large bell the core is placed in a deep pit in the foundry floor and the case is carefully lowered over it. The space between the core and the case is a perfect bell of air which will be displaced in a short time by the molten metal.

The case is securely bolted down to the cast-iron ate on which the core formed, as the hydrostatic pressure of the molten metal, which is very great in the case of some of the mammoth bells, would otherwise float the case and allow the metal to escape.

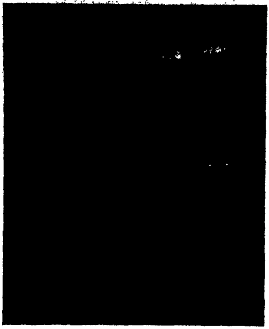


Above: A bell-shaped sand core is built up on a brick center. *Left:* An iron case or outer mold is lined with damp sand

"Casting day" is always interesting to visitors at the foundry. A number of bells are usually cast on the same day. The casting of a ten-ton bell can be accomplished in about ten minutes. The composition of the alloy varies somewhat, but great care is always taken to insure that only the purest metals are melted together. Expert supervision is given to the processes of preparation, melting, and casting.

In preparation for pouring, a cast-iron box is fitted to the top of the case and in this there is formed a chamber to provide a "head" of metal, with a circular opening leading down to the bell. A cone-shaped plug is arranged so that it can be raised or lowered to control the flow of metal as required during pouring.

THE bell metal, pure copper and tin, which has previously been heated for several hours in a reverberatory furnace, is now tapped into an iron ladle, and the scum, which floats on the surface, is raked off. The foreman in charge takes the wheel of the tilting gearing of the ladle and turns it over till the metal begins to run out into the "head," an assistant holding the lever which controls the plug. When a good amount of metal has been poured into the head the plug is lifted, and while the metal is running in, the plug is kept in such a position that the clean metal from the bottom of the head never runs into the mould faster than the metal is poured from the ladle, thus keeping all the scum and dross on the surface of the metal in the head. In 24 hours for a small bell and perhaps two weeks for a large bell, the metal is cool enough for the case to be lifted off, exposing for the first time the finished bell, which, after still further cooling, is lifted off the core plate, laid on its side, and the core broken away from the inside. While in this position any inscription or ornamentation is cleaned



Lowering the case onto the core in the pit before casting

up with a sharp chisel to remove the hard burned sand sticking between the letters, and the fins of metal at the joints of the moulds are "fettled" off.

The bell, on its way through the machine shop, is stopped to have drilled in the top the holes which will be used for hoisting and suspending. It then goes to a shed, where all dirt on the surface is cut away by a powerful sandblast, leaving the metal smooth and clean. From there it goes to the tuning shop. Here it is placed mouth upward on the revolving table of a large boring mill, to which it is firmly secured by bolts and clamps, and the metal is cut away from the inside until not only is the strike note in tune with all the other bells in the carillon, but also various harmonics and octave overtones are in accord. This, as may be imagined, is the work of highly skilled experts, involving much time and great care and patience.

THE bell is then brought into the main erecting shop to join its brothers or sisters, or to await their arrival, and, in the case of a large bell or "bourdon" a massive steel headstock is fitted, with trunnions working in roller bearings. It is then lifted into its steel swinging frame, steel wheels are added, and the wrought-iron clapper fitted inside. This clapper plan is one of the three methods of striking this particular bell and is used when it is swung for church services, or possibly for tolling on special occasions; it rings "half up," that is until the tip of the bell is vertical, and the two wheels are driven by electric motors and automatic gearing. It can also be sounded by a hammer that falls on the sound bow, or, for carillon action, by a counter-balanced clapper which is pulled rapidly against the outside of the bell.

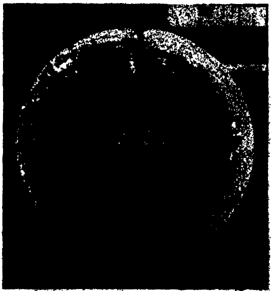
If the bell is not one of those which swings, it is suspended from the steel beams with a suitable insulating material between the bell and the steel, and is struck t the sound bow by an internal clapper, the strokes being given by hand pressure on one of the claviers operated by the carillonneur. The bells which are stationary can also be struck by means of outside hammers operated by gravity to give the "quarter chimes."

The foundry is often required to correct defects in bells. When it is possible to correct to a reasonable extent the harmonies of each bell in an old group, while putting the group into tune as a whole, this is done with the utmost care. In each case where it is found that the harmonies of an individual bell are too false for appreciable correction, it is recast, using the same metal, unless there are historical or sentimental reasons against such a procedure. On the other hand, a bell that is really bad, but worthy of retention in its present form owing to antiquity, is usually preserved in the church while a new one takes its place in the belfry.

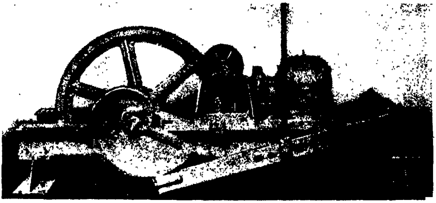
The belfry of the Riverside Church, which is located in the 392 foot tower, is 40 feet wide and 63 feet high. The bells are disposed in three tiers or stories within this huge cavity and the carillonneur, Mr. Kamiel Lefevere, sits (at present) within the operating chamber in the middle section at the console. He has complete control over the 72 bells which run in weight from the "bourdon" weighing 40,880 pounds, to a six-inch. 10-pound bell tuned to "C."

AT present these bells are operated by four different methods: 1. By arillonneur's console, giving delica- of touch and expression; 2. Five of heavy bells are swung by automatic lectric mechanism as a call to services, n special occasions; 3. By electropneumatic mechanism and long-distance control fro the church or chapel organ consoles; 4. By automatic hour striking and quarter chiming mechanism. The hours are struck on the "bourdon" by a clock-controlled mechanism, and the quarters are chimed on any number of bells up to four octaves by means of a revolving barrel five feet diameter studded with electric contacts which can be changed for varying the music of the chimes as often as desired.

There are also pedals like those of the organ to actuate some of the bells. The small bells play easily by the hand levers free from mechanical help, but in the case of the



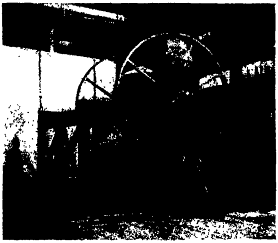
After the casting is cold the core is broken down leaving the bell ready for the finishing larger bells electrical contacts bring an electro-pneumatic system into play. Even with this powerful aid expression is not lost sight of and the carillonneur has three gradations of power to use, giving soft, medium, or loud blows.

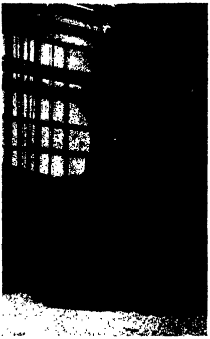

The motor-driven, clock-controlled mechanism for striking the hours on the "bourdon." The outside hammer is attached to the end of the upright rod at the right

In a small room several floors below the belfry is the clock proper, a compact and neat piece of delicate mechanism the duty of which is to keep accurate time and at the right moment send an electrical impulse to start the hour striking and quarter chiming mechanism. Both of these units stop themselves when they have struck the correct number of blows on the bell. A program wheel has an adjustment for silencing both the hours and the quarters during the night. Each hour the clock automatically winds up the 20-pound weight that keeps it going. The clock has no dials as the church is Gothic and the dials would not be in accordance with this style of architecture.

The total weight of the bells is over 100 tons and the steel work weighs 140 tons. The clapper for the "bourdon" weighs 4000 pounds and the clock hammer 1000 pounds.

As may be imagined, a careful lay-out of the switch-gear and wiring has been necessary, for on no account must the external hammers or clappers strike the bells while they are swinging, and it must be impossible for two operators to play the bells from different places, the carillonneur's console and the organ console, at the same time. A control panel is placed beside the carillonneur; when he wishes to play he presses one button only, labeled "start" and this starts up the power plant, cuts out the quarter chiming gear, and cuts off all controls from the organ consoles. After playing, the button "stop" is pressed and this stops the power plant, releases the quarter chimes, and connects the organ controls again. In both cases telltale lamps light up to show how the controls are set. The pressure of either button starts motors which switch over 157 wires from one system to another.


The largest bell is swung by motors and is also struck by power-actuated hammers at *A* and *B*


Tuning is done by removing metal from inside bell by a boring mill

The new bells for the Riverside Church. The "bourdon" weighs 20½ tons and is swung and struck at different times. The larger bells are placed below the console

On March 3rd 1928 two thousand four hundred ringers from all parts of England gathered at Croydon to witness the casting of the great 20½ ton "bourdon" for the Riverside Church. Among the visitors were 41 ringing clergymen and 71 lady ringers. The Archbishop of Canterbury made an address and a great "bell concert" followed, which included hand bell ringing items by famous ringers.

We are indebted to Mr. R. F. A. Housman, M. I. Mech. E., General Manager of Gillett and Johnston, Ltd., for the interesting series of pictures and for much help in explaining the action of this beautiful carillon in its lofty belfry.

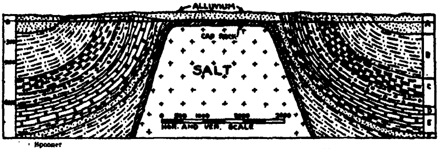
SALT DOMES*

By M. F. KNOY

Efficiency Engineer, Gulf States Utilities Company, Lake Charles, Louisiana

TO THE casual observer the Gulf Coast region of Texas and Louisiana offers no spectacular topographic features such as are met with in other sections of the country. Its pine forests, densely wooded swamps, broad prairies, and extensive marsh lands, while possessing a certain scenic charm, offer no natural wonders to the traveler's eye.

One must not conclude from this, however, that the region is devoid of any interesting feature. On the contrary it is one of the most famous localities in the world from a geological standpoint, owing to the numerous subterranean salt domes that occur here. Salt domes occur in other parts of the world, notably in Germany and Roumania, but nowhere have they proved of more scientific interest or of greater economic value than here on our own Gulf Coast.



Spooner

Figure 1: Cross-section of a typical salt dome in the Gulf Coast section

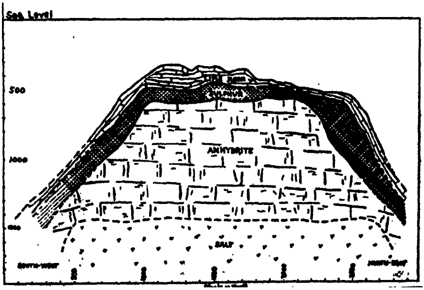
As the name indicates, the typical salt dome is a more or less imperfect cone of rock salt, rising from several thousand feet below to within a few hundred feet of the surface. A good idea of the form and extent of such a dome may be gained from a study of Figure 1. The body of salt in the various domes will of course vary as to size and shape and in other details, but the general plan is the same.

Space does not permit of a discussion of the various theories of salt-dome origin that have been offered in the past. Suffice it to say that many eminent geologists have made a study of the subject, and at present they are agreed in a general way as to the manner in which these peculiar structures were formed. They know that vast deposits of sodium chloride, or common salt, exist at a depth of several thousand feet below the surface in various parts of the earth. They also know that any rock will flow if subjected to sufficient pressure, and that rock salt will flow more readily than any of the more common rocks of the earth's crust. Hence, the theory is that during past ages uneven pressure, due to gentle folding of the crustal rocks, has caused the salt to flow upward through weak points in the overlying strata.

As would be supposed, these overlying strata have been highly compressed, bulged upward, and in many cases broken entirely. Much of the rock directly above the salt has been thrust to the surface and carried away by erosion. Figure 1 illustrates this condition of affairs. Of course the process should not be thought of as something in the nature of a sudden catastrophe, but rather as a slow upward movement requiring for its total rise of several thousand feet a period of tens of thousands of years. In many cases erosion of the uplifted rock has kept pace with its elevation, so that to the untrained eye the surface may offer little evidence of the dome beneath. Usually, however, the site of the dome is marked by a surface prominence or a mound of varying height and several hundred feet in diameter.

SOMEWHAT over 40 salt domes have been located in the coastal plain of Texas and Louisiana, and several more are known farther inland in each state. The existence of salt springs on the site of certain of these domes was known to the earliest white settlers and even to the aborigines. In the case of Avery Island, a dome near New Iberia, Louisiana, the white men found a surface deposit of ashes and potsherds five acres in extent and reaching a depth of three feet in places. These ashes were presumably from the fires of prehistoric red men who evaporated the brine over open fires and reclaimed the salt. The enormous extent of the ash deposit would indicate an accumulation of hundreds of years, and no doubt the place was the scene of a thriving salt industry in the days of our savage precursors. But the existence of the salt springs was unknown to the Indians found in the region by the white men.

A number of domes have been worked for salt at various times and in



After [illegible]

Figure 2: Showing the position of the sulfur deposit at Sulphur, Louisiana

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various ways. In some cases water is pumped into the salt formation and withdrawn again, carrying the salt in solution. The brine is then evaporated and the salt reclaimed. In other cases shafts have been sunk into the salt. Here the lump substance is loosened by light blasting, loaded on small flat cars and hoisted to the surface. It is then crushed, sized, and prepared for distribution.

Huge quantities of salt are produced by the latter method in the three famous salt mines, Jefferson Island, Avery Island, and Weeks Island, near New Iberia, Louisiana. The product from these mines is of unusual purity, often testing over 99 percent pure sodium chloride.

Salt was discovered on Jefferson Island about 1895, but was not worked commercially until 1923. Since that time, however, production has been on a large scale. Large scale production was begun at Weeks Island in 1902. By 1924 a total of more than 2,000,000 tons had been produced, and at that time the annual production was more than 200,000 tons.

AVERY ISLAND was used as a source of salt by prehistoric Indians as mentioned above. The salt springs here were discovered by a white hunter in 1791, and when during the war of 1812 England stopped the shipment of salt from Liverpool to the States, a shaft was sunk and production started on Avery Island. After the war, however, the competition of imported salt caused production to be discontinued in 1817. Again during the Civil War, when salt became scarce in the South, production was resumed at Avery Island. It is estimated that some 10,000 tons were supplied the needy Confederacy before a Union army, under General Banks, destroyed the works in 1863.

After the Civil War several unsuccessful attempts to operate the mine were made. In 1899, production was put on a paying basis, and continues so at present. Up to 1924 a total of 2,500,000 tons had been produced, and the annual production at that time was 100,000 tons.

Despite the huge quantities of salt that have already been removed from each of these mines, scarcely a sign has been made on the known deposits which in each case still contain hundreds of millions of tons of high grade salt.

Some of the Gulf Coast salt domes have a cap of sulfur-bearing rock. The origin of this sulfur is not definitely known, but is usually regarded as the result of the reduction of calcium sulfate, or anhydrite, by oil and natural gas in the porous strata surrounding the dome. Some salt domes have little or no anhydrite on them and hence no sulfur. Other domes seem to have brought up from below a cap of anhydrite which in some cases is several hundred feet in thickness. In these a heavy deposit of sulfur is often found at the top of the anhydrite. Figure 2 shows the position of the sulfur deposit in the dome at Sulphur, Louisiana, one of the most famous sulfur producers.

An airplane view of Spindletop, famous salt-dome oil field near the city of Beaumont, Texas. Compare the distribution of the wells with the typical figure placed below it

Sulfur was discovered here about the time of the Civil War, but was not profitably exploited until about 1903, after the noted chemical engineer, Herman Frasch, had perfected a practicable method of production. By this method wells are drilled through the sulfur-bearing rock. Water at about 300° F. is pumped into the porous rock to melt the sulfur, and the molten product is brought to the surface by means of an air lift. It is then run into enormous vats where it cools and solidifies. The walls of the vats are then pulled down and the material is ready to be broken up for shipment. A stranger to the region is sometimes astonished to see at a distance of several miles a huge, golden lump of pure sulfur, containing several hundred thousand tons, glistening in the sunlight.

From 1903 to 1924 some 9,000,000 tons of sulfur were produced from the Sulphur dome. Since that time the sulfur mining has been abandoned and the flanks of the dome explored for oil. Today it is an active and valuable oil field.

The Frasch system of production, which was perfected at Sulphur, is now in use on other similar deposits, notably the one at Gulf, Texas. Though there is commercial production at only a few points, it is on such a huge scale that since 1917 the Gulf Coast mines have supplied most of the world's sulfur. And, when we consider the enormity of the known deposits and the economical recovery made possible by the Frasch system, it is likely that they will continue to do so for many years to come.

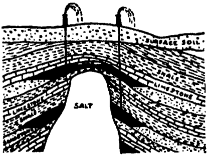

Figure 3: Ideal conditions for oil

The Gulf Coast region is underlain by several oil-bearing strata. Though these strata may be encountered almost anywhere, oil in paying quantities is found only where they have been faulted, ridged, or domed. The accumulation of oil at such points is due to the fact that these strata are permeated by both oil and water. Since oil is the lighter of the two liquids, it is floated by the water to the highest accessible point. Thus the ideal oil pool is found where there is an elevated point in oil-bearing strata, and where the underlying and the overlying strata are of dense formation that will prevent the escape of oil. Figure 3 shows diagrammatically how a salt dome may bring about these conditions.

Today there are 18 producing oil fields in the Beaumont district of Texas and Louisiana, with development under way on several others. Most of these fields are on proved salt domes. Salt domes have made this region an important factor in the nation's oil production. It has likewise become a great refining and export center, with a refinery capacity of 100,000,000 barrels per year. This means that approximately one tenth of the entire refinery capacity of the nation is located at Beaumont and Port Arthur, Texas.

The following abstract of a paper by D. C. Barton and R. B. Paxson on the Spindletop field at Beaumont will give an idea of the importance of salt domes to the oil industry: "The Spindletop oil field was the first and one of the most brilliant of the Gulf Coast oil fields. Spindletop is a characteristic Gulf Coast salt dome and is composed of a steep-sided, relatively flat-topped, circular salt core with a diameter of about one mile, and with a limestone, anhydrite, gypsum cap surmounting the salt. Most of the oil was produced from the porous, cavernous limestone at the top of the cap. The early gushers have never been equalled in the United States for the size of their daily flush production. Few fields in the United States of like size (265 acres) have had as big a production. This totaled 30,000,000 barrels in the first three years and over 50,000,000 barrels to 1924."

In 1925 a deeper pay sand was discovered in this field, and since that time an additional 50,000,000 barrels have been produced, bringing the total production to over 100,000,000 barrels to date. The present production is at the rate of about 900,000 barrels per month.

Since the occurrence of oil on the Gulf Coast is so frequently in connection with a salt dome, the first step in the search for new oil fields is the discovery of other salt domes. A novel and interesting method has been devised for the purpose, and several of the major oil companies keep crews in the field with this object in view.

THE instrument employed is the seismograph, a delicate apparatus first used to record faint earthquakes. Three of these instruments are set up about a mile apart, each in turn being about a mile from a heavy charge of explosive, usually consisting of 250 pounds or more of dynamite. A man is stationed with the seismograph and another attends to setting off the explosive. When all is ready radio signals are exchanged, instruments are accurately timed, and the charge is fired. The blast is of terrific intensity, sufficient to rattle window panes for miles around and to set up distinct vibrations in the earth. If these vibrations reach all of the instruments in the same length of time the test is blank, no salt dome being indicated. But if there is a marked difference in the time shown by the various instruments it is a favorable indication and the vicinity will be closely explored.

It has been found that the ordinary rocks of the Gulf Coast transmit sound waves at the rate of about 5000 feet per second, whereas, rock salt transmits sound waves at the rate of about 15,000 feet per second. Thus when the shock reaches one of the instruments much more quickly than it does the others the presence of a salt dome is indicated between this instrument and the explosive. This method is very reliable when used by skilled operators. It has been used to locate several salt domes whose presence could not have been ascertained from surface indications alone.

The Gulf Coast salt domes are truly of great scientific interest. And when we remember that during the past 30 years they have yielded millions of tons each of salt, sulfur, and petroleum, and that they have been the direct source of wealth and employment in more than a score of communities, we realize that they are also of tremendous economic importance.

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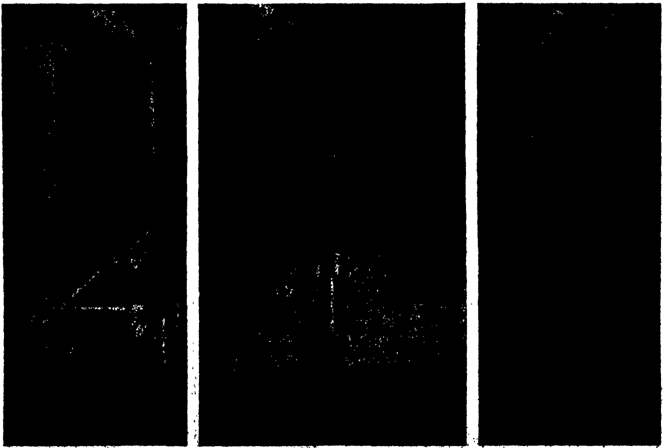
This is the first of three articles dealing with minerals recovered in connection with salt domes. The second will deal mainly with sulfur; the third with geophysical methods in the search for salt domes with reference to the discovery of oil.—The Editor.



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The Frasch hot water process of mining sulfur. Hot water from plant at left passes down within outer, six-inch well tubing (note arrow marked "hot water," within central circle), passes out into rock through perforations, melts sulfur. This rises within smaller, three-inch pipe, and is helped to surface by air bubbles from central one-inch piping

WHICH RACES ARE BEST?

Why Science Can Not Admit Racial Differences in Intelligence

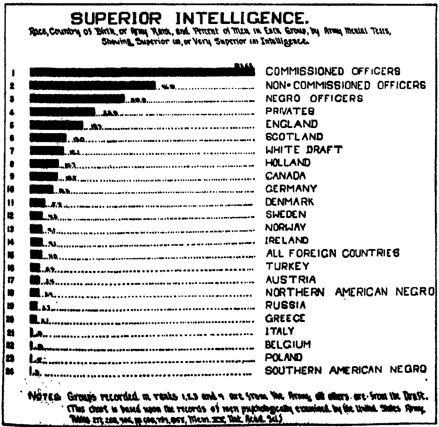
By G. H. ESTABROOKS
itant Professor of Psychology, Colgate University

WE hear a great deal about the superiority of the Nordic. Apparently he is some kind of direct descendant from the ancient gods of the Greeks and Romans. Before him all other races pale into utter insignificance and leave—or at least should leave—to him a monopoly of brains, brawn, and virtue. If, however, you will review the numerous works which have placed this fair-haired, blue-eyed giant on his pinnacle of perfection you will find they are all written by authors who have no especial training which fits them for their position as judges of human destiny.

Actually the problem of racial superiority is one which must be solved by the expert. When you have a problem in chemistry you go to the chemist—not to some layman who is merely interested in chemistry as a side line. You would never think of having anyone but a trained engineer build a modern factory, nor anyone but a competent physician treat you for smallpox. Similarly there are certain branches of science which are especially entitled to pass judgment on the problem of Nordic superiority. The anthropologist and the psychologist must solve this question between them—and their solution is in sharp contrast with those of many of our popular writers.

Science has not as yet demonstrated the existence of racial differences in intelligence. The reason for this is fairly obvious. First, let us consider what the anthropologist would have to say on the subject. He studies the past history of all races. His interests are largely of an historical nature. Just where did such and such a race come from? Why did the long-headed peoples in Europe give way before the round heads about 10,000 years ago? Who first domesticated animals and who is responsible for the wonderful civilizations which once flourished in Egypt and in Central America? These and such questions as these are the ones in which he

Now, he says, "you wish to talk on racial intelligence. An excellent idea, but let us start by finding out just what you mean. Just what do you mean by a race?" Here we receive our first jolt, for the anthropologist defines "race" in terms of physical or bodily characteristics. Thus the people of the North European race are fair-haired, blue-eyed, tall individuals with long, high heads and thin noses. The term "Nordic" can be properly applied only when we speak of people having these characteristics. Then there are two other races in Europe, according to the generally accepted classification. One of these is the Alpine race which chiefly inhabits the center of Europe but which has pushed out into all corners of the continent. The third is the Mediterranean race. The Alpines are short, thick-set people with brown hair, brown eyes, and a round head. The Mediterraneans are short, slender, with black hair, brown eyes, and a long, low head.



A typical example of the unfair findings the author inveighs against, in which the alien, not wholly familiar with English, is pitted against the American

IF we are going to talk about *racial* intelligence within the white race we must confine ourselves to this classification or to some other similar division of races based on strictly physical data. Thus the English are not a race; they are a nation. It would be of no use talking about the inferiority of the Italian race—if it were inferior—because there is no such thing. The Italian nation comprises a mixture of all three races, and the Nordic who throws stones in that direction is very likely to raise a lump on the head of a member of his own group.

Similarly the Jews are not a race. There are tall Jews and short Jews, blue-eyed and brown-eyed, fair-haired and dark-haired, long-headed and round-headed. One might prove the Jew either superior or inferior, to one's heart's content, but it would have absolutely no bearing on the racial question. Indeed, even when the Negro "race" and Indian "race" in the United States are considered, one is almost as badly off, since both are largely mixed with whites and with each other.

So the first criticism of the anthropologist would be that almost all the work done on so-called racial intelligence had, with a very few exceptions, been done instead on national intelligence.

The second argument which the anthropologist would advance is the historical one. We tend to look at things as they are, not as they may have been in the very near past. For example, the foundations of our culture go back to Egypt, Babylon, and Greece. From such countries as these came our real higher civilization, while such things as the domestication of animals and the cultivation of our great food plants go back even farther. The anthropologist would point out that the Nordic had nothing whatsoever to do with these beginnings of our cultural life. The Mediterranean seems to have made the real contribution, while many of our most useful food plants came from the American Indian.

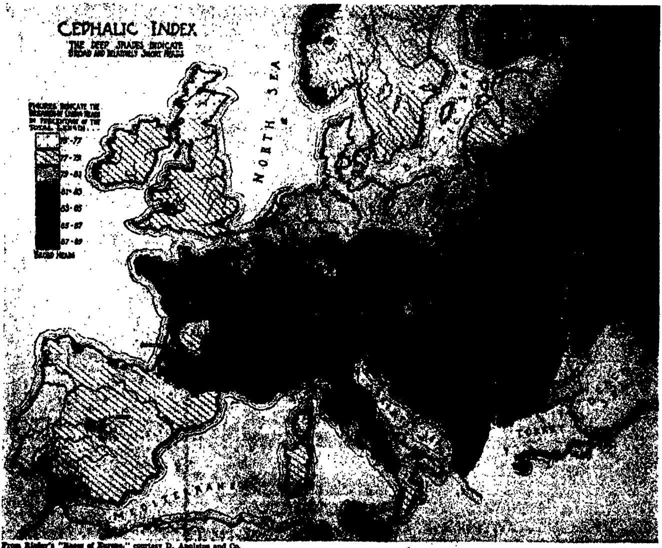
Even as late as the 15th Century A.D. the Nordics were savages, compared with the people living in southern Europe. The anthropologist realizes this fact. He realizes that the despised Indian of Central America had a very high civilization in 500 A.D., when the Saxons were heathen pirates whose sole interest was plunder and destruction; that the Chinese built the Great Wall at a time when the crude Nordic was just learning to use iron; and that the Egyptians and Babylonians had a written language and a high culture when the inhabitants of northern Europe were just learning to tame certain wild animals and plant certain grains.

In other words the Nordic is very much in the place of the *nouveau riche*. Just at present he happens to be doing very nicely but his history is very short indeed compared with that of certain other races.

WHEN we turn to psychology, the other branch of science which is interested in our problem, we find that the psychologist is very suspicious about this whole business. He tries to measure intelligence with the so-called "intelligence test" and does a very good job with school children when they have had the same type of environment. He is worried, however, when others try to apply his results to different races and nations.

For example, there is the language handicap. I have no right to test an Italian child with an intelligence test written in English, when that child has not a thorough knowledge of the English language. The best piece of work of this kind has been completed in the Philippine Islands. The results were very interesting. About 32,000 children were given several intelligence tests. Now, these children could not speak English very well. It was found that when they were given an intelligence test which was written in English they were far inferior to American children of the same age. But when they were given what we call a non-language test, a test which is designed in such a manner that it does not matter what language the subject speaks, then there were no differences whatsoever between their intelligence and that of American children.

The psychologist will not even allow us to sidestep this question by pointing to the negro, who is certainly familiar with English. Intelligence as measured by the intelligence test depends very largely on how and where you were



From Ripley's "Races of Europe," courtesy D. Appleton and Co.

Over three decades ago William Z. Ripley, ignoring the relatively recent accidents of history which have made nations, measured many thousands of heads in Europe and discovered Europe's three racial stocks: the Nordic long-heads on the north, the Alpine broad-heads in central Europe (the great dark wedge on the map), and the Mediterranean long-heads brought up. To be sure, the negro does generally fall below the white on these tests, but no one who is familiar with conditions in the south can claim that the negro has as good a chance to be educated as his white neighbor. We hear a great deal about negro inferiority but there are one or two facts which are often overlooked by the advocate of white supremacy.

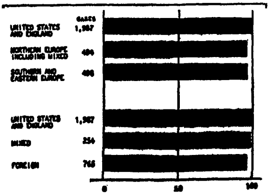
For example, the northern negro as seen in such places as New York City is actually superior in intelligence to the southern white, if we are to believe the results of army tests. Home conditions have a very great influence on these intelligence tests, as do also the amount of schooling and similar factors. The psychologist realizes these facts and is careful about making sweeping statements on such evidence. Unfortunately many popular writers get hold of these test results and promptly jump most unwarranted conclusions.

FINALLY, there is another point in the argument which is advanced by the biologist. We say, for example, that the Indians or the inhabitants of the South Sea Islands are inferior because they are rapidly vanishing before the advances of the white man—they can not withstand his civilization, therefore they must be of inferior intelligence.

This, however, is by no means the case. What actually is wrong is that these peoples simply can not withstand the white man's diseases. For instance, when Cortez first attacked Mexico City he received a disastrous repulse. The Spaniards under his leadership were the first white people whom the ancient Mexicans, the Aztecs, had [illegible] Despite the fact that the invaders were armed with powder and steel, the Indians fought bravely. But the Spaniards brought another ally even more terrible than superior weapons. This was smallpox. Between the first and second attacks on the city one half of the male population had died from this scourge. It was then a much more easy task for Cortez to reduce the survivors to submission.

Similarly, everyone who comes in contact with the Eskimo is greatly impressed with his intelligence. But the Eskimo is doomed. He has little resistance to the diseases of the white man. Tuberculosis and smallpox wipe out whole tribes. The South Sea Islanders are in no better situation than the Eskimos and are rapidly dying out because of this hopeless fight against disease.

The white man naturally feels that such peoples are very inferior. They can not resist sickness as well as himself; therefore he very often looks down on them in all respects, intelligence included. But intelligence has nothing whatsoever to do with it. Indeed, recent research suggests that even the European may rapidly degenerate if placed under the living conditions of some primitive races. We find, for example, that certain animals, such as the white rat, will give birth to defective offspring if forced to live on a diet containing alcohol, or if they have their thyroid gland injured.

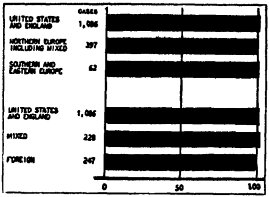


Arithmetic scores of children by racial parentage again show essentially equal intelligence

This branch of experimentation is new but it contains the suggestion that anything which weakens the body, such as alcohol, insufficient food, or disease, may lead to defective children and so to race degeneration. If this is true we can well see how a new disease, such as malaria, might easily lead to a mighty race becoming a very weak one.

When we sum up the evidence we find that science is unwilling to give any race the crown of intellectual superiority. Results have been wholly inconclusive, and even the rabid exponent of intelligence tests is becoming more and more moderate in his claims. Ten years ago he looked over the results from the famous Army Tests and neatly catalogued all races on this earth as to the order of their mental ability. Today he attacks the problem far more cautiously with much better tests, and frankly admits that he is badly puzzled [illegible]

Can we definitely solve this problem of racial intelligence? Possibly, but it is one of the most difficult which science has ever faced. First, we must test races, not nations. We have talked a great deal about Nordics, but no one has ever, to my knowledge, taken a group of true Nordics—that is, people with fair hair and blue eyes, tall, with long. high heads and thin noses—and compared them with a group of typical Mediterraneans—short people with black hair and brown eyes, long low heads and medium noses. Thus no one has yet taken the trouble of even attempting a first step. This statement may be harsh, for certain investigators, such as Garth, have done excellent work comparing Indians and other races with the white race. Even Garth himself would probably admit that his research was far from accurate as regards an exact determination with reference to the purity of his groups.



Illustrations on this page from Edmund de S. Brunner, "Immigrant Farmers and their Children," courtesy the Institute of Social and Religious Research

Intelligence tests on American-born children of Nordic and non-Nordic stock, with language disability eliminated, show practical equality

FROM this point on, however, the problem becomes extremely difficult. If we are to measure intelligence we must use intelligence tests. So suppose a research worker chooses a Nordic and a Mediterranean group. In the first place, since the language handicap is a serious difficulty, he must either have these two groups speak the same language or give [illegible] he must be able to guarantee that their cultural background is the same, or that this cultural background has absolutely no effect on the test he is using. This is hopeless at present. The mere fact of using a "non-language" test does not eliminate the possibility of other factors in the cultural background having a very definite effect.

Granted, however, that we shall have reached this far distant goal and shall have finally proved the Nordic superior to the Mediterranean, what next" Science would point out that this merely a *present day* finding. Where now are the people who built the pyramids or who founded the wonderful culture of ancient Greece? They were then the great leaders in culture. The north European was an uncouth savage.

The despised Nordic has mounted the throne, but there are other peoples anxious and possibly able to hurl him from it in the near future. Such is the teaching of history. We must be more charitable in our views toward others, for some day they may have occasion t exercise charity toward us.

MORE ABOUT THE GREAT SIBERIAN METEORITE[1]

By J. G. CROWTHER

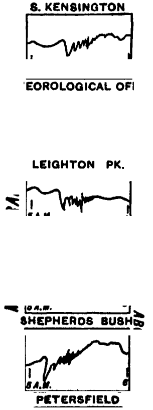
Author of "Science for You"; "Short Stories in Science"; "Science in Soviet Russia." Scientific Correspondent to *The Manchester Guardian*

THOSE readers of the SCIENTIFIC AMERICAN who live in the United States, Canada, and Japan and keep diaries may be able to provide some special information of value to meteorologists. It concerns the atmospheric and sunset effects of the great meteorite which fell in Siberia in 1908 and devastated over a thousand square miles of forest. That the fall actually took place became generally known only in 1928 and since then some remarkable new information has been discovered.

Line of travel of air waves across England from the Siberian locality

The subject of one of the discussions at the Dublin meeting of the British Association for the Advancement of Science in 1908 was wave-motion. Dr. W. N. Shaw (now Sir Napier Shaw) contributed an example of a curious atmospheric wave-motion recorded on the self-recording micro-barograph invented by himself and Mr. W. H. Dines in 1903. This instrument automatically records sudden small changes in atmospheric pressure such as those due to air-waves (that is, sound waves when audible) but not slow changes due to ordinary rising or falling of the barometer. It registers the frill, as it were, on the continuous but slowly varying line which represents the record of the pressure of the air.

On June 30th, 1908, six of these instruments in England, respectively at South Kensington, Meteorological Office, Leighton Park, Cambridge, Shepherds Bush, and Petersfield, recorded a series of air waves arriving during a period of about 20 minutes, with about four fairly plain maxima, as if there had been four disturbances or explosions somewhere in the earth's atmosphere during that period. After the discussion this record was more or less forgotten and became one of the unexplained curiosities of meteorological science.

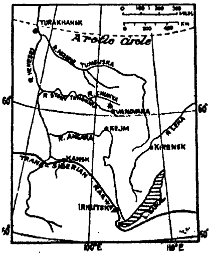


Oscillations at several points in England, June 30, 1908—until recently these were unexplained

Since 1928 fragments of news from Russia have conveyed the information that a great meteorite had fallen in Siberia on June 30th, 1908, and expeditions had been made to discover the place of fall. In 1930 the eminent English meteorologist Mr. C. J. P. Cave suddenly remembered that the date of the Shaw micro-barograms corresponded with this date of the meteoric fall. Were the English micro-barograms due to the air waves caused by the great meteorite said to have fallen in Siberia? This discovery greatly stimulated interest in the reports of the Russian explorers. The expeditions were led in Siberia by the geologist Professor Kulik. I met him in Leningrad last autumn and heard something of his experiences directly, and also had as a kind gift from him several photographs (the ones reproduced—*Ed.*) taken in the area devastated by the meteorite as it fell.

IN Russia in 1908 there were rumors that a meteorite had fallen near Kansk in the Yenesei region of Siberia. The earthquake observatory at Irkutsk had recorded a small shock on the morning of June 30th. At Kirensk the sounds of the explosions were heard and various stories of terrific events having occurred in the north were noticed in the newspapers. Apparently these records were ignored by Russian scientists at the time, and no investigation of them was made until 1921, 13 years later. Russia was then stricken with poverty and famine after the

Illustrations at left and below, from the *Quarterly Journal of the Royal Meteorological Society*



Where the Siberian Meteorite fell —indicated by star near center

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[1] See "The Great Siberian Meteorite", *Scientific American* July, 1928—a preliminary account by Professor Charles P. Olivier. Further discussion appeared in the *Literary Digest*, March 16, 1929—*Ed.*

struggles of the revolution. Nevertheless Kulik, Oldenburg, and Wernatsky of the Academy of Sciences approached Lunacharsky, the Commisar of Public Instruction, for funds to finance a preliminary expedition of inquiry in the Kansk district to discover whether the old rumors were worth further investigation. The funds were given and Kulik led the inquiry in Kansk, returning to Leningrad definitely convinced that something extraordinary had happened on June 30th, 1908, in that region of Siberia, and that a thorough exploration of the district was necessary.

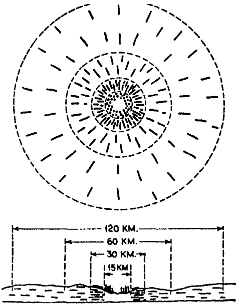
IN March, 1927 he led a second expedition from Kansk to the Yenesei district. They marched through blizzards with temperatures of -40 degrees Centigrade to reach Keshma on the River Angara. There they formed a caravan for Wanawara on the River Tunguska. They engaged a Tungus guide to lead them into the crater region. The Tungus had a family of four and ten reindeer. He would not start in the morning without deep potations of tea and then not earlier than 10 A.M. In the afternoon he refused to move after 4:30 P.M. and on halting commenced more endless drinking of tea. They could proceed only from one patch of vegetation to another in order to get fodder for the reindeer, so with these handicaps and the difficulty of the country they could not cover more than four or five miles a day.

Finally the explorers reached the craters. *These proved to be from 30 to 150* feet in diameter and about 12 feet deep. The bottom was covered with swamp [illegible] and the craters the earth was crinkled in a direction at right angles to the southwest and northeast line. Round about the craters the ground had been entirely blasted and at the time the meteorite fell every living thing must have been quite consumed.

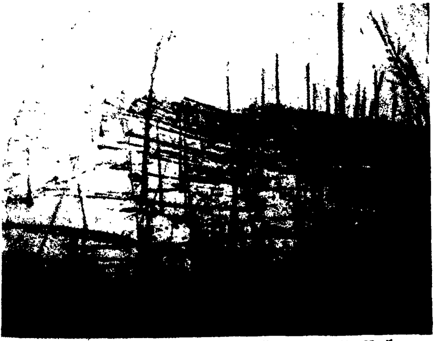
Professor Kulik told me of one remarkable feature: within the central blasted area was a ring of upright trees. The trunks are seen to be stripped or singed of foliage. The fact that they remained upright while all vegetation inside and for some distance outside the ring was destroyed seems to suggest that they mark some kind of node or region of rest due to interference of air waves coming from the craters. Some of these trees are shown in one of the photographs. From a pencil diagram Professor Kulik drew for me, one sees that the central area which was devastated except for the ring of upright trees, was about fifteen to twenty kilometers (roughly, 10 or 15 miles) in diameter. Beyond this circle was a ring of felled trees extending up to a diameter of 30 or 40 kilometers, as shown in the diagram. The next zone extended to about 60 kilometers diameter and contained a considerable number of felled trees, while occasional trees were found felled within a diameter of 120 kilometers or about 75 miles. Throughout the circle the trees were felled radially from the craters.

In the devastat [illegible] living vegetation was less than 20 years old. For example, in one of the photographs, a young tree less than 20 years old is seen standing among dozens of felled tree trunks.

Professor Kulik believes a great outrush of hot air produced by the change of kinetic into heat energy when the meteorite crashed into the earth blew the forest trees down and singed rather than tore off their branches and foliage. He said that he and his party had dug 30 feet into the crater bottoms but had not found the meteorites. The boring is difficult because the soil is eternally frozen below half a yard and considerable equipment is required. He is not sure whether the meteorites are sunk in the earth or whether the craters are the marks of a ricochet where the meteorites struck the earth a glancing blow and then flew off into space again, or perhaps vaporised on the spot. He is not yet certain whether the meteorites approached from the north or the south. If they came from the north he believes they may have been connected with the comet Pons-Winnecke, or indeed they may have been the comet itself.



Sketch showing the effects of the meteoric fall. Redrawn from a sketch by Professor Kulik



In the distance-zone roughly between 30 and 60 kilometers—say, 20 to 35 miles—from the center a part of the trees remained standing. Compare with the drawing

In 1929 Professor Kulik led a third expedition to the region, taking with him Chudnovsky, the famous Russian arctic airman and rescuer of Nobile. They intended to make an aerial survey but the weather was adverse and it could not be made. The difficulties of the country were great. They must explore while the land is not too deeply covered with snow, yet they must also leave before the thaw sets in. The thaw is very rapid and the rivers such as the Angara and the Tunguska rise several feet in a few hours, flooding

Typical Siberian country, heavily forested as in the corresponding forest belt of Canada but never glaciated. Reproduced from a photograph by Professor Kulik

the country and making it impassable. Then a terrible plague of mosquitoes arises and this apparently is one of the worst of the obstacles. Professor Kulik's expeditions have left a mark on him. He is a tall, wiry, bronzed man of Scots figure, lean and a little tired. Perhaps a rest will soon entirely refresh him.

The Kulik expeditions have stimulated much remembrance of atmospheric disturbances on June 30th, 1908, and the succeeding days. The reports of inhabitants who were interrogated by Kulik and his colleagues are interesting. I. I. Illinski, now a stationmaster, was at the Lialka Siding at Kansk. "Suddenly I felt what seemed to be a violent vibration of the air and heard a loud noise. I was terrified. The engine driver of train Number 92 was so scared that he stopped the train, fearing it might be derailed, and when he reached us at the siding asked us to examine the train to see whether some of the goods might have exploded." An observer near the Arctic Circle heard three or four (compare with the Shaw micro-barograms) dull thuds in succession. Professor Kulik told me that the explosion was heard at points within a circle 2000 miles in diameter; south of Lake Baikal, in Mongolia, for example.

S. B. SIMIANOFF of Wanawara said that after "the flame disappeared there was an explosion which threw me off my feet a distance of seven feet or more. The glass and frames of the house broke and clods of earth were spit up from the square in front of my hut." Kosolapoff said that the door of the Russian stove flew out and into a hammock on the far side of his room. The glass from the windows burst inward. Afterward there was a sound like the roar of thunder from the north. Dr. Whipple remarks that this evidence indicates that there was a pressure wave which broke windows inward and was followed by a suction wave which sucked clods out of the ground and hurled the stove door across a room.

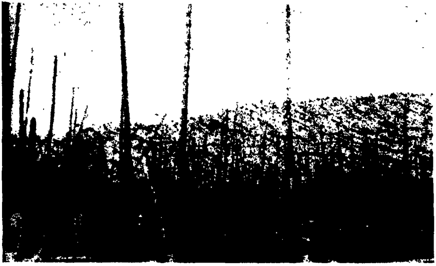
A Tungus called Ilia Potapovich said that his brother was living on the Chambe River when a terrible explosion occurred. For miles along both banks of the river the trees were uprooted. His brother's tent was hurled down, the wind carried away the top, deafened his brother, and dispersed his reindeer, many of which he was unable to collect when he had regained his senses. These events affected him so that he was ill for a long time. In the part of the forest which was uprooted a big hole appeared. The Tungus road formerly passed this place but now it is avoided as the Tunguses are terrified of the locality. The informant Kartashoff who gave this information of the Potapoviches said he did not believe it was true. Here is an example of the type of incredulity which caused the Siberian meteorite to remain uninvestigated so long.

Many other reports referred to the devastation of the forest and the felling of the trees in uniform directions—one to the destruction of several Tungus families and one to a forest fire. The Tungus's terror of the district will be understood when I report that Professor Kulik told me the occurrence had caused the evolution of a new tribal religion. They regarded the arrival of the meteorite as a visitation from a God named Agdy (meaning Fire) to punish the wicked. The place is believed to be accursed. The destruction of vegetation removed the sources of food for animals, so that the subsequent scarcity of living things made the place seem sinister. The development of a myth whose circumstances and date of birth are exactly known possesses considerable interest for comparative anthropology. (Similarly the Navajo have a superstition regarding the descent of one of their gods at Meteor Crater in Arizona. SCIENTIFIC AMERICAN, September 1927, page 246.—*Ed.*)

THE *Bulletin* of the Russian earthquake observatories had three references to the occurrence in 1908. In the town of Kansk the first shock caused doors, windows, and a votive lamp to shake. There were subterranean rumblings and a second shock came five to seven minutes later. A minute later there was another shock. At the Kuriske-Popovich village a severe earthquake was felt. Afterward there were two loud bursts like the firing of cannon. Earthquake shocks were also registered at Tashkent and Tiflis, but their connection with the Kansk phenomenon was not recognized. Since then an earthquake record for the appropriate time has been found at Jena in Germany. The Director of Irkutsk Observatory ascertained that the meteorite had fallen near the River Tunguska about 400 miles from Kansk, but nothing more was done about it.

A young tree less than 20 years old, which appears to be a birch, growing among the decaying trunks of the forest laid low in 1908 by the meteorite's air blast

Since the significance of the Shaw micro-barograms of 1908 became understood the records of the atmospheric and earthquake effects of the meteorite have been very interestingly discussed by Dr. F. J. W. Whipple, the Superintendent of Kew Observatory, London. As the Tunguska district, Cambridge and Petersfield in England lie approximately in a line (see a globe—*Ed.*), the time of travel of the atmospheric disturbance from Cambridge to Petersfield, at each of which it was recorded, will give its speed. This proves to be about the velocity of sound, according to expectations. By comparing the hour of the disturbance in Siberia with the hour of the arrival of its air waves near London, the time of travel is found to be five hours and ten minutes, which is about right for a journey of 3550 miles, the distance from London to the place of fall.

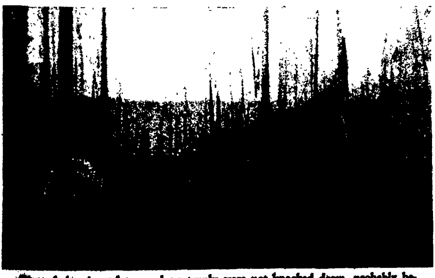


Local effects of topography. The trees on the exposed hillside were entirely felled while part of the slightly protected trees on the level in part escaped

THE sound of the meteoric explosion in Siberia was heard in London by instrumental means, if not by human ears. The English micro-barograms furnish data which permit estimates of the energy of the disturbance. According to formulas derived by Professor G. I. Taylor, Dr. Whipple calculates that the meteorite must have had energy at least equal to that of a body weighing 12 tons traveling at seventy-two kilometers (45 miles) a second. Professor Kulik estimated the meteorite to weigh 130 tons. One may assume that only a fraction of the energy would pass into air waves, so the two estimates agree quite well.

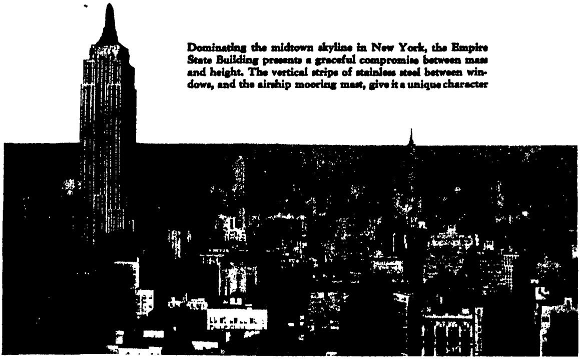
Beside causing earthquake records at Irkutsk (589 miles distant), Tashkent (1890 miles), Tiflis (2727 miles), and Jena (3240 miles), and no less than six detailed air-wave records in England at an average distance of 3550 miles, the meteorite caused immense sunset effects in many parts of Europe at least, as scores of weather diarists are now proving. During the night of June 30th, 1908 "a strong orange-yellow light became visible in the north and northeast, causing an undue prolongation of twilight lasting to daybreak on July 1st, when the eastern sky was an intense green to yellow-gold hue. The entire northern sky on these two nights, from the horizon to an altitude of 40 , was of a suffused red hue varying from pink to an intense crimson. There was a complete absence of scintillation or flickering, and no tendency for the formation of streamers, or a luminous arch, characteristic of auroral phenomena. Twilight on both of these nights was prolonged to daybreak and there was no real darkness. At 1 A.M. on July 2nd small print could be read without the aid of artificial light. The phenomenon was reported from various places in Britain and on the Continent, from Copenhagen, Königsberg, Berlin and Vienna." So writes Mr. Spencer Russell in an article just recently published in the *Quarterly Journal of Meteorology*.

A member of the staff of Greenwich Observatory took an excellent photograph of the Royal Naval College shortly before midnight with an exposure of about one minute. The famous astronomer Wolf of Heidelberg found he could not take star photographs owing to the fogging of the plates due to the unwonted luminosity of the sky. He considered that the effects must have been due to dust which developed in the highest parts of the atmosphere on June 30th and gradually settled during the following days. At 7 P.M. on June 30th de Veer of Haarlem, Holland, saw something to the northwest which he described as an undulating mass. It was not cloud, for the blue sky itself seemed to undulate. Presumably it was due to dust from the meteor and had taken 18 hours to cover 97° of longitude, giving a speed of 300 kilometers or about 185 miles per hour. On the morning of July 2nd Wolf noticed a peculiar wisp of cloud moving apparently at 220 miles an hour. Unfortunately the dust cloud could not travel entirely around the globe in 24 hours at that speed and meteorologists want to know whether Wolf was observing the object seen by de Veer on the previous night, after having passed right around the globe and arrived back again. The evidence of observers in the United States, Canada, Japan, and countries south of the line from England to the Crimea, whether they noticed this object on its journey round the globe in the upper atmosphere, would be valuable.



Part of the ring of trees whose trunks were not knocked down, probably be- al or interference effect. Tungus guides and horses in foreground

HOW strange that a cataclysm leaving traces in many parts of the earth should pass almost unrecognised for 20 years, and then require geologists, seismologists, meteorologists, even airmen and anthropologists for its elucidation.



Dominating the midtown skyline in New York, the Empire State Building presents a graceful compromise between mass and height. The vertical strips of stainless steel between windows, and the airship mooring mast, give it a unique character

THE ULTIMATE IN SKYSCRAPERS?

By ANDREW J. EKEN

Vice-President and Chief Engineer, Starrett Bros. & Eken, Inc.

THE battle for the possession of the world's highest structure goes on apace in New York. Billions of dollars have been spent, millions of tons of steel and stone have been reared from Manhattan's rocky base in the struggle to come nearest to a literal interpretation of "skyscraper."

Nearly a quarter of a mile into the air, the Empire State Building now towers 102 stories above Fifth Avenue and 34th Street on the famous old site, first of the farmlands of the Astor family and later of the Waldorf Astoria Hotel. Construction beyond this height, while far from impossible, is uneconomical. Space becomes too expensive to bring adequate return. New York land is too expensive to assemble easily a plot large enough to support a building topping the Empire State.

It has taken just 19 months to demolish the Waldorf Astoria Hotel and erect in its place the greatest structure ever conceived by man. It is topped with a mooring mast designed to be the terminus of transatlantic dirigible services of the future and will be populated with 20,000 busy workers who are visited each day by an estimated 40,000 floating population.

"Just for the record," as former Governor Alfred E. Smith, President of Empire State, Inc., which owns the building, would say—this structure is 1248 feet from sidewalk to tip of the mooring mast and contains 85 stories of tenantable office space. This compares with the Chrysler Building's 1046 feet from ground to the tip of its spire with 71 floors of office space; with the Eiffel Tower, useless for any purpose more practical than sightseeing, but 995 feet high; and with the Bank of Manhattan Building, 927 feet high with 76 stories of tenantable space. Naturally the erection of such a structure brought peculiar engineering problems to the planners and builders of Empire State.

WHILE the removal of the Waldorf was under way, Shreve, Lamb & Harmon, architects, struggled mightily with the Empire State plans. Fifteen times the building was created on paper and 15 times rejected for some economic or technical fault. Finally came the sixteenth plan, which is Empire State as it stands today.

Demolishing the Waldorf was no easy job. It is customary for wreckers either to pay for the privilege of removing a New York City building or to do it free of charge for the value of the materials they can salvage, but the Waldorf Astoria proved too staunchly built and before the last broken fragments of its walls had been removed 900,000 dollars had been spent in cutting the still sound steel columns to pieces with flaming torches and in carting the remains far out to sea to be dumped from barges. The Waldorf now lies beneath the Atlantic Ocean 15 miles beyond Sandy Hook.

Even before the wreckage was cleared from the great hole in the ground, the Empire State foundation—giant blocks of concrete built to support the largest steel columns ever fabricated, weighing over 12 tons to the foot—were being placed.

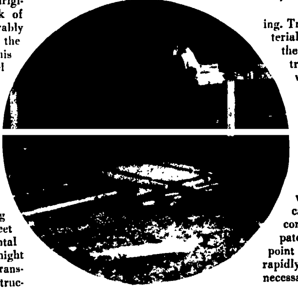
Rapidly the work progressed until only five months after the first steel was set, the American flag was raised on the 86th floor to signalize the completion of the framework. Already the exterior masonry had been raised to within a few floors of this steel work. Then came the building of the 200-foot mooring mast towering above the 86th floor sightseer's observatory. The basketlike steel framework was built by daredevil steel workers casually placing rivets and swinging girders higher than man had ever reached before, until the giant revolving cap of the mast was placed a quarter of a mile above the street. This mast is enclosed with glass and with ribbons of the same shining stainless steel and aluminum which distinguish the exterior of the entire building in shining straight lines from the sixth to 85th floors.

An elaborate system of wind bracing protects this tall structure against the stress of any gale which may blow through New York's canyons. This problem of wind bracing has given much concern to civil engineers. Professor C. R. Young of the University of Toronto has estimated that the pressure of a normal wind on the Empire State Building amounts to 4,340,000 pounds; therefore the building must count on a wind pressure of 20 pounds per square foot for the first 500 feet of height, increasing at the rate of two pounds for each successive 100 feet. A wind of 186 miles per hour, the highest velocity recorded in this country, would therefore produce a pressure of 102 pounds per square foot on a building such as Empire State. Walls and partitions were found by the engineers to be of little if any assistance in wind bracing; therefore systems of bracing the actual steel framework to bear this terrific load were evolved by Mr. H. G. Balcom, consulting engineer on steel erection. This bracing is even more necessary in the tall dirigible mooring mast, the framework of which must necessarily be considerably lighter than that of the rest of the building. At the very peak of this mooring mast a Gothic form of steel arch is placed, the apex meeting at a central point to which the mooring ring of a dirigible tying up to this mast would be fastened.

A red neon light warns aircraft of the towering tip of this mast and an elaborate system of lights outlines its shining column. The four principal columns which compose this mooring mast are carried down through the building all the way to the bedrock, 33 feet below the surface so that the horizontal pull which a moored dirigible might exert upon the mast will not be transmitted to the higher parts of the structure but to the massive concrete foundations instead.

Fifty-eight thousand tons of fabricated structural steel were placed in the Empire State Building, the largest single order ever given for work of this kind and so great an order that no single mill could produce the quantity desired in the time specified. The load on the four central columns is in excess of 10,000,000 pounds, more than 5000 tons to each. Because of the necessity of moving daily such quantities of material into the building, an elaborate and ingenious way of scheduling the arrival and even the manufacturing of the materials needed was devised by the contractors, Starrett Bros. & Eken. An individual railway system was constructed to cover every floor of the Empire State Building. Trucks bearing steel and other materials, instead of being unloaded in the street, where they would obstruct traffic and deface the neighborhood, were taken directly into the ground floor of the building and their loads placed upon small cars running on the steel tracks and turntables of this construction railroad.

Giant derricks lift part of the hoisting machinery to be used by the constructors


A portion of the builder's railroad in the building, meeting an elevator

The daily work of each of the many derricks and hoists for materials was so scheduled that engineers in charge knew exactly what any conveyance would be carrying at any given hour. Each consignment of materials was dispatched to the nearest hoist to the point at which it was needed and so rapidly lifted upwards that it was never necessary to use any large amount of storage space or to delay the steady flow of trucking to the building. Eighty hours after steel was fabricated in the Pittsburgh Rolling Mills and loaded upon flat cars it reached the Empire State Building, each piece marked carefully with symbols indicating the exact position it was to occupy in the framework and even the number of the derrick which was to lift it to its place. More than 50,000 individual pieces of steel reached the building in this manner and were placed according to schedule without delay.

The operating mechanism and cable drum of a work elevator. At the right is a large dial which shows the movement of the elevator from floor to floor

THE exterior of the building is of Indiana limestone and granite with vertical strips of the now well-known stainless steel, creating an entirely new architectural effect in their straight narrow lines which shine in the sun. Windows were designed to be set flush with the outer walls, doing away with window reveals and creating in the aggregate thousands of additional square feet of usable space in the interior of

Oxy-acetylene torch used to cut notches in beams for inserting concrete floor reinforcing

the building. Radiators, likewise, are recessed into the walls, also increasing available space.

Sixty-two express, signal-controlled elevators have been installed in the Empire State Building by the Otis Elevator Company. These are of the self-leveling type, automatically stopped and started by the pressing of buttons within the car numbered for each floor. A special device developed for use for the first time in the Empire State Building was installed by the Otis Company to take the place of human dispatchers. This electrical device prevents any two elevator cars from stopping to answer a given call and wasting the time of one of the cars. It likewise dispatches cars from the ground floor on their trips through the building at carefully spaced intervals to give smooth continuous service to incoming cars. These elevators will travel at a speed of 1200 feet a minute, the limit allowed by the New York building law. This law previously made provision for an elevator speed of only 700 feet a minute and was only recently changed.

EXPERIMENTS conducted by the Otis Elevator Company have determined that 1200 feet a minute is approximately the limit which the human body can stand, although it is possible technically to produce elevator cars capable of traveling nearly 2000 feet a minute. Empire State express cars will travel from the first to the 80th floor in slightly over a minute. At the 80th floor, passengers desiring to travel to the 86th floor observatory or to the mooring mast will change for a tower car which will lift them the rest of the way. A single elevator will travel through the center of the mooring mast to a room at the top large enough to accommodate 50 people. The weight of elevator cables makes it impossible to make the journey from the ground to the 86th floor in one lift.

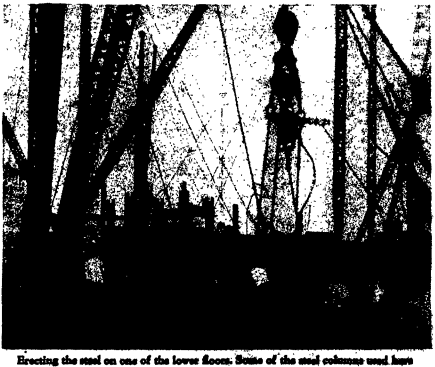
During construction exceptional safety precautions were taken. At all portions of the building where exterior masonry or other work was being done, secondary scaffolding and nets were erected to prevent any materials or tools from falling into the street. All elevator shafts were carefully fenced off from portions of the building where workmen were employed and doorways arranged so it was almost impossible for anyone to enter the shaft to a position where he might be struck by a moving car. Telephone systems connecting various portions of these shafts were used to synchronize the movement of materials and to prevent confusion.

Empire State stands on a plot of 197.5 feet by 424.95 feet. The area of this site is 83,860 square feet and the rentable floor space within the building is 2,158,000 square feet, making it the largest office structure in the world. An average of 2500 men was employed daily in the construction work, while the total sometimes reached as high as 4000. To care for this army of workers and to dispatch them in and out of the building, a stagger system of hours for beginning and quitting work was established and four portable cafeterias were erected and moved about as the work progressed, to save the men the time otherwise necessary for going outside the building for lunch. Fifty miles of temporary water piping were installed for the convenience of these workmen and a complete hospital, with doctors and nurses always in attendance, was established.

Empire State statistics are staggering in their magnitude and it will be interesting to read some of them. For instance, 3500 kilowatts of electricity will be consumed when the Empire State is fully tenanted. This is enough to light a city the size of Albany, New York.

THE steel contained in Empire State framework could be rolled into a double track railroad reaching from Montreal to New York. Four and one-half stories of steel work were erected every week. There are more than 2,000,000 feet of electrical cable in the Empire State and adding this to telephone and telegraph wire placed in service, the total would stretch nearly twice around the earth. There are 6400 windows, 10,000,000 bricks, 200,000 cubic feet of stone, 400 tons of exterior chrome-nickel (stainless) steel, seven miles of elevator shafts, and enough floor space to shelter a city of 80,000.

Shreve, Lamb & Harmon were responsible for the design of the building and H. G. Balcom was consultant on steel erection. Meyer, Strong & Jones, Inc., were engineers for the installation of utilities and Post & McCord, Inc. erected the steel framework for Starrett Brothers & Eken, Inc., the general contractors. The company owning the building is headed by Alfred E. Smith and includes in its directorate Pierre S. DuPont, Louis G. Kaufman, August Heckscher, Ellis P. Earle, John J. Raskob, and Michael Friedsam.

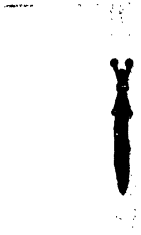


Erecting the steel on one of the lower floors. Some of the steel columns used here were the largest that have ever been fabricated for a building or other structure

FROM THE ARCHEOLOGIST'S NOTE BOOK

"Scramasaxes"

ARMS and armor of the period around 600 A.D. are quite rare, so the Metropolitan Museum of Art is very fortunate in receiving a gift of the three pieces shown. The meaning of the word "scramasaxe" is uncertain but it denotes a knife. The three are representative works of so-called barbaric art—the makers were admittedly skilled craftsmen even if they were barbarians.



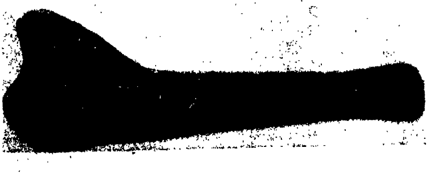
Frankish and Gallic daggers, "Scramasaxes," were emblems of power

The earliest piece to the right is of the late iron age, 100 B.C. to 100 A.D., and is Gallic. The other two pieces are Frankish of about the 6th Century. All three daggers were undoubtedly found in graves where they were placed with the supposition that their owners would need them in the here-after.

A Stolen Relief

THERE is a beautiful Greek marble relief of Pentelic marble in the Metropolitan Museum of Art that probably dates from the 5th Century B.C. A battle scene is represented. A little detective work makes it possible to trac

Below: Greek sword sheath for Scythian. *Right:* Detail of ‹ at



in it also the hand of Rome. It will be noticed that the back of the slab is smooth except for a ridge about 3⅞ inches from the bottom. This suggests that the relief was cut with a saw as far as the ridge and then broken; as was customary in Roman times and still is today. The sawing evidently took place in antiquity—presumably by the Roman plunderers who carried the relief from Greece to Rome—in order to lighten its weight. Lord Elgin did the same to the slabs of the Parthenon frieze. This accounts for the unusual thinness of the slab.

Right: A Greek marble relief which was broken from a marble block to save weight. *Left:* Back of relief showing marks of saw before being broken

A Scythian Work of Art

A BEAUTIFUL Greek sword-sheath covering, made from a thin plate of gold for a Scythian king who dwelt in southern Russia, depicts a contest of Greeks and barbarians and dates from the end of the 5th Century B.C. The gold was beaten out over a die and the details chased afterwards. The metallic

made for a sword 22 inches long, and has the characterist projection for fastening it to the belt. The sheath proper, presumably of leather, has disappeared. The Museum is fortunate to possess such a piece, made when Greek art was at its height.

Iranian Bronzes

NINETEEN bronzes found in Luristan, a mountainous and inaccessible region of western Persia, have just been acquired by the Metropolitan Museum of Art. They consist of pole tops, figures of animals, horse trappings, pins, and bracelets of unusual design and shape. Most of the pieces come from graves. The small figure of a deer belongs to the Bronze Age. The bronzes may be assigned to a period from the 6th to the 4th Century B.C. The elaborate pole tops with heraldic animals are of r interest. The specimens art of a hitherto unkn Ira

Iranian bronzes from western Persia. Most of the pieces come from graves. The art of nomads of a hitherto unknown branch

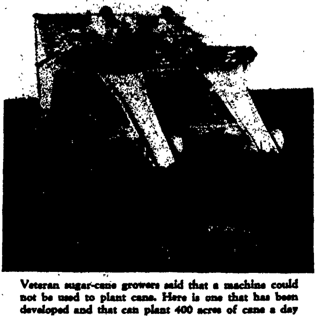
The Celotex plant at Marrero, Louisiana

AN INDUSTRY THAT WAS MADE-TO-ORDER

By A. E. BUCHANAN

"GREAT oaks from little acorns grow." In the colorful history of American business, the old proverb has been applied to the little machine shop that became an automobile factory and to the newsboy who became a captain of industry. But this is the tale of a new kind of a business romance in which an industry was literally built to order in a single decade. It is the story of a group of men armed with the tools of science, who, disregarding the acorn, visioned the mighty oak and methodically proceeded to build substance into their dream.

It has been long recognized that the average home, artificially heated in cold weather, is an excellent radiator to warm up "the whole outdoors." Until about ten years ago, however, only the wealthy could afford to build heat-insulated houses, using the flax, animal hair, or wood fiber materials then available. To our little group of industry builders, with the engineer's inherent distaste for wasted energy, it seemed but elementary common sense that any building for human occupancy should be designed to retain heat in winter and exclude it in summer. Accordingly they set out to create a new structural material that would bring insulating properties within the reach of every home-builder.



Veteran sugar-cane growers said that a machine could not be used to plant cane. Here is one that has been developed and that can plant 400 acres of cane a day

The first requirement for the new industry was a fiber which would be available annually in large quantities. This fiber must be low-priced and hence must be a vegetable waste without food value or other economic worth. Cornstalks, flax, cereal straws, hemp, and wood fiber were considered. From the chemical standpoint, some of them seemed suitable, but there were economic objections to their use. Some of them had value as cattle feed; some had already found industrial uses and most of them would involve an expensive collection system because they are produced by many scattered farmers.

Finally the investigators came to bagasse, the fibrous refuse that remains after the juice is extracted from sugar cane. Sugar cane is grown in large, concentrated areas throughout the world. The juice is extracted by crushing the cane between rollers. The residual fiber is light and bulky and would form a tremendous pile of refuse at the sugar mill unless some means were devised to dispose of it. Because of the tough, spiny character of its fibers, bagasse cannot be used for cattle feed. It is so resistant to decay that it cannot be plowed back into the soil to form humus. The only way to get rid of it was to burn it and this was the general practice at sugar mills. Although its combustion produced a portion of their steam requirements, the sugar millers knew it to be a very inefficient fuel.

Having determined that bagasse offered the ideal raw

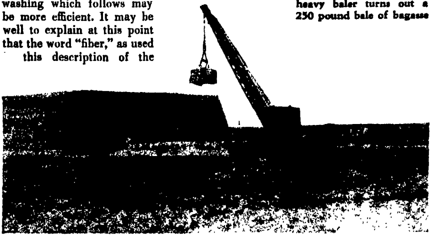
Harvesting sugar cane in the Florida Everglades. The refuse left after extracting the juice is the material on which has been built a vast made-to-order industry

material for their new industry, our industrial pioneers, after much persuasion, made an arrangement with a sugar plantation at Houma, Louisiana. Under its terms, they converted the furnaces in the mill to burn natural gas, which was conveniently available, and agreed to pay the fuel value of the bagasse, plus a profit, for the entire output of the mill. Part of the agreement provided that bagasse must be removed from the mill as produced in order that it might not interfere with the crushing operation during the busiest season of the year. The first crushing season, that of 1920, witnessed a daily battle to get away from the mill 300 tons of bagasse every day. Not only was the battle won, however, but so decisively was the feasibility of the whole project demonstrated that today the sugar cane industry of Louisiana owes a large part of its prosperity to the utilization of a by-product; the bagasse that was formerly burned is now converted annually into approximately five hundred million square feet of insulating board, trademarked Celotex.

The mills of The Celotex Company are located at Marrero, just across the Mississippi River from New Orleans. In the illustration at the top of the opposite page may be seen the huge piles of bagasse bales, stored to await processing. Bales of bagasse are delivered as needed to the mill where they are broken open and conveyed on an endless belt to the cooker room, where the bagasse is dumped into great rotary digesters, 14 feet in diameter. Here it is cooked under pressure, in order to make the [illegible] steril- [illegible] soluble organic matter.

After cooking, the fiber is pumped through shredding machines in order to break up the large shreds so that the washing which follows may be more efficient. It may be well to explain at this point that the word "fiber," as used [illegible] this description of the manufacturing process, refers to a suspension of fiber in water. By keeping the bagasse fiber at a 2 to 3 percent consistency, it can be pumped and otherwise handled as though it were liquid.

A specially designed extra heavy baler turns out a 250 pound bale of bagasse



Since the raw material for a year's manufacture of Celotex is produced during [illegible]n of about three months, large storage space is essential

From the shredders the fiber is discharged into rotary washers where the dirt, soluble organic and mineral compounds, and a certain amount of pith are washed out. From the washers the fiber passes to stock chests which are large wooden vats, fitted with powerful rotating agitators to prevent settling. In these stock chests the sizing agents, mainly rosin and alum, are added. The next step is the refining of the fiber in order to produce uniform shreds of the proper length and width.

AFTER passing through a series of beating and rendering operations, the fiber is ready for the manufacture of Celotex and the "stuff" is pumped to the board-forming machines. Here the pulp is changed from a liquid suspension into a damp board of uniform thickness. This operation is accomplished on specially designed machines composed of two distinct parts, the mold rolls and the presses. On each machine there are two mold rolls, 6 feet in diameter and 13 feet long, covered with wire mesh and together forming the front end of a vat into which the thin pulp is admitted. The rolls rotate toward each other, acting like filters. The water drains out through the wire and a thick layer of pulp builds up on the wire surfaces. This layer of pulp is then carried over the rolls, between heavy belts of felt, which conduct it through presses where the excess water is squeezed out and from which the matted pulp emerges with a moisture content of 50 to 55 percent. The wet board now passes to the dryers which are 1000 feet long and large enough to accommodate two or three sheets of board each 12½ feet wide. The dryers are steam and oil heated, being provided with coils supplied with high-pressure steam and fans which carry off the moisture as it is driven from the board by the heat.

The board comes from the dryer in

A board machine in a Celotex plant. At the high end the water is drained and the cane fiber (bagasse) is formed into a continuous sheet which passes through pressure rolls and on down, through the floor, to the drying chambers beneath

practically a bone dry condition and will take up about 8 percent moisture when stored under ordinary atmospheric conditions. In order to season the board, therefore, it is sprayed with clean water as it emerges from the dryer. This seasoning is very important because it prevents buckling when the sheet is used for construction purposes. After the board is sprinkled, it is automatically cut into desired length and width by revolving knives. The knives run at slow speed and have emery wheels attached to keep them sharp.

Celotex has found a wide variety of applications, not only in building construction but also in the industries. In the former field it is used as sheathing, as a base for plaster walls, for roof insulation, as an interior finish, and for sound insulation of offices, auditoriums, and so on. Industrially, it is used in railroad refrigerator cars, for domestic refrigerators, in ice cream, bottle dispensary and similar cabinets, as radio loudspeaker baffle-boards, as a base for linoleum, in aircraft and hangars, for expansion joints in concrete, for sign boards, and for special packaging. It has even been used for making tennis court surfaces, pipe gaskets, archery targets, oil filters, table pads, automobile radiator shields, and art screens.

AN interesting special form of this product is known as Acousti-Celotex. As its name implies, it is designed to utilize the sound-absorbing properties of the material. It is made in the form of tiles, each tile composed of two or three laminations of insulating board, and drilled almost through with 441 holes per square foot, thus increasing the sound-absorbing power of the material.

Perhaps the most interesting phase of this romance of a made-to-order industry is the startling economic development that has followed in its wake. At the time when the first experiments were being conducted, the cane-sugar industry in the section of Louisiana known as the Sugar Bowl was facing extinction. The yield of cane from the once productive lands was falling to an unprofitable minimum. Government experts advised the planters that the continuous planting of Louisiana cane had so weakened the strain that it could no longer withstand the rigors of weather, insects, and parasites. The United States Department of Agriculture recommended planting certain varieties of cane produced in Java by scientific cross-breeding. But the Louisiana planters were skeptical, discouraged, and financially crippled.

It was at this time, in 1926, that The Celotex Company, because of its need for the bagasse that had formerly been an almost useless by-product, injected itself into the raising of sugar cane. New capital was raised for a thorough trial of the theories advanced by the government experts. The new variety of cane thrived. The yield per acre jumped back to a profitable figure and the Louisiana Sugar Bowl was saved from bankruptcy. Not only did the new cane produce more sugar, but appropriately enough, it yielded a better grade of bagasse than the older variety.

As a result of this experience, the Celotex interests organized subsidiary companies which developed land in the Florida Everglades for sugar cane raising. This work involved an engineering achievement of no mean proportions for it was necessary to construct a huge system of dykes and ditches to control the water that had brought grief to all former attempts to cultivate this swampy area. Also, the land in its natural state was not suitable for cane culture. But it was found that the addition of 75 pounds of copper sulfate per acre of land brought the drained soil to fertility within six months.

But these industrial pioneers have done more than this. They have demonstrated an entirely new principle in agricultural economics by completely industrializing the age-old business of raising sugar cane. In the words of E. C. Lathrop*, Director of Research of the Celotex Company, "The securing of fiber and sugar is being thought of, not in terms of agriculture, sugar milling, fiber manufacturing, but as a continuous inter-related and inter-locking industrial problem, beginning with the drainage and character of the soil and ending with the finished fabricated article in the hands of the customer."

IT is not unreasonable to envision a time when other branches of agriculture may join forces with the chemical engineer to elevate lowly by-products to a dignity equal to that of the crop itself, thereby creating new industries and solving the economic problems of agriculture by industrializing the farm.

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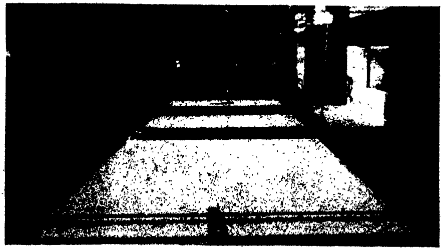
*The author wishes to acknowledge his indebtedness to Dr. Lathrop, who supplied both the data and the photographs for this article.



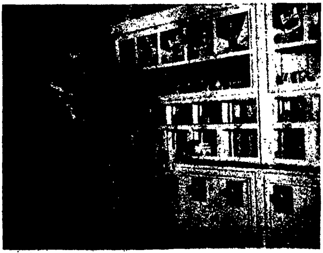
As the pressed sheets of insulating board emerge from the driers onto the conveyor, they are cut by revolving knives into smaller sheets of the required size

The customer is buying a packaged steak from a refrigerated unit. Another steak will take its place, being lowered by endless chains

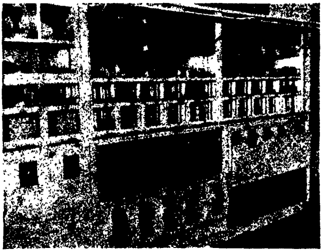
A TWENTY-FOUR HOUR AUTOMATIC MARKET

WE recently had the privilege of inspecting the first of the "Delamats" or automatic markets where meat and groceries are sold. The idea is to dispense either refrigerated or unrefrigerated food from coin controlled containers. The first installation has been made in a room on the ground floor in a large apartment house in West 44th Street, New York. In the daytime a girl makes change and sees that the machines are supplied with their merchandise. When she leaves she empties all the coin containers and the outfit carries on, until the next day, without human aid. The units are of two kinds; one is built into a large General Electric refrigerator and the others are adapted to handle merchandise at room temperatures. When the cost of the article is less than the coin or coins to be inserted, change is returned automatically. The goods are well displayed and the insertion of a coin or coins and a turn of a knob starts the motor and delivers the goods to the customer. The machine then brings down the next article on a tray attached to endless chains. A small motor actuates the entire mechanism. The systems employed are the inventions of Mr. N. Robert Harvey who has spent several years in their design and development for commercial use.

Right: **Detail of unit showing chains, descending trays carrying merchandise, and clutches**

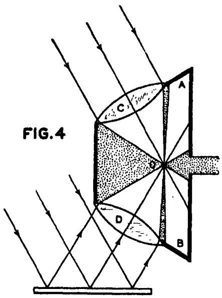


Mr. Harvey explaining his system. Note the visibility of the goods and also the opportunity for advertising wares



The mechanism is operated by an electric motor by means of a shaft, clutches, and endless chains carrying trays

FIG. 4



Beams of light enter dark box A, B through lenses C, D and cross at focus O. Eye is at P

But the absence of scattering in the experiments of Hughes and Jauncey is capable of another interpretation. Light as we recognize it today has a dual aspect. In some ways its quanta act like corpuscles and in other ways as waves. In the theory underlying their interpretation of their results Hughes and Jauncey emphasized the corpuscular side of the quantum to the neglect of its wave aspect. Now wave trains, as is well known, can ordinarily cross each other without difficulty. This may be seen in the case of ripples in still water. If emphasis be laid on the wave aspect of light it would seem that no scattering at crossing is to be expected.

BUT when the amplitude or intensity of the wave reaches a certain point the wave form, at least in water, becomes unstable and breaks up. This may be seen at the seashore where the incoming rollers increase in height until they finally break in a shower of spray. And it might have been possible that the two beams of light employed by Hughes and Jauncey could have been each so intense that their sum would have surpassed the limit of stability. As it appears, this did not happen.

A quantum of energy, it seems, has no definite size such as characterizes an atom of matter. A quantum may be originally contained in a single atom of a star. Leaving this abode, it may travel outward into space, continuously expanding without limit, for all we know to the contrary. By means of lenses or mirrors it may again be compressed to a very small size, again apparently without limit. And it appears that sometimes a quantum will contract of itself to a size so small that it can be totally absorbed by an atom, or even by the still smaller electron. This is believed to take place in what is called photo-electric action.

When light of the proper color falls upon certain substances electrons are emitted, copiously if the light is bright, more sparsely if t light is faint, but no mat how feeble the light th emission of electrons start immediately when the ligh falls upon the sensitive substance.

Sodium, for example, will respond in this way when exposed to light of any color between the yellowish green and the violet of the spectrum, but light at the other end of the spectrum, between yellowish green and red, will not excite this action no matter how intense or long continued it may be.

What is the mechanism of this process? Where does the energy of the emitted electron come from?

These questions might be easy enough to answer if we neglected quantitative considerations. It might be said that the electron was almost able to break away, and that the light exerted a trigger action of some kind, releasing it from confinement. But there is a curious quantitative relation between the energy of the emitted electron and the energy of the quantum which liberates it. If we wish to obtain electrons of high energy content we must supply light quanta of equally high energy. Quanta of less value will produce electrons of lower energy or perhaps none at all.

To use an illustration which is not new, suppose a plank falls from a ship into the water and sets up a series of waves, which travel onward, continually growing less intense, until they reach another ship at some distance away. Nothing would surprise u than to see a plank of the same weight detached by the ripples from the second ship and flying up into the air to a height equal to that from which the first plank had faller

Something very like this happens in the photo-electric effect, and in the face of this quantitative relation the trigger explanation fails. Here we have a first class mystery. There is not enough energy at any point in the wave front to do the work, and yet somehow or other the work gets done. Does the widely extended quantum, when it encounters a waiting electron, gather itself together and whisk into the electron like the genie into the bottle in the Arabian tale?

MUCH yet remains to be learned about the quantum. We have evidence sufficient to warrant us in believing in its existence; we know a little about the way it behaves; but whether it be wave or particle or both at once we are as yet doubtful. Yet the quantum concept has been the most fruitful of all the new concepts of 20th Century physics, surpassing even the theory of relativity; and while the theory of relativity seems to show signs of reaching a barren stage the quantum theory is still lusty and vigorous.

Ruling a standard meter bar by means of interference fringes. Mr. C. G. Peters of the National Bureau of Standards is at the interferometer in the foreground

CLEMENCEAU AND FOCH

A Biographical Study of Two Fearless Frenchmen

By **CAPTAIN W. D. PULESTON**

BIOGRAPHIES greatly influence history. It is only by the disclosure of the personal viewpoint and the influences which govern action, that events can be properly judged.

So many biographies of wartime leaders have appeared and they are so voluminous and contradictory, that the average reader is completely confused.

The author of this article is internationally known for his judicial, keen, and searching analysis, and here presents a resumé which we believe will be recognized as historically important.—*The Editor.*

IN the darkest days of the last German offensive on the Western Front in the spring of 1918, when their armies approached nearer to Paris than they had been since September, 1914, it was Georges Clemenceau, French premier, who roused the flagging spirit of that sorely tried nation for the last struggle with the invaders. Alternating unceasingly between the French trenches and the rostrum of the Chamber of Deputies in Paris, he imbued the French troops with his own fierce determination to continue to fight until victory was won, drove from the French councils defeatists like Caillaux, and dared to execute the traitorous Bolo Pasha. When he became Premier, Clemenceau was already a familiar figure to the French poilu, for he had so often plodded through the trenches, covered by a dark greatcoat, with soft hat whose narrow brim pulled sharply down over his weather-beaten face, that his stocky, rather stout silhouette gradually assumed a remarkable resemblance to the well known outline of the French private with his trench hat and field coat.

Clemenceau entered French public life as a member of the Chamber of Deputies in 1876, an extreme radical, an anti-clerical, and a devoted adherent to the Republic. In 1880, he founded a paper, *La Justice*, that speedily became the organ of the Paris radicals. In the Chamber and through his paper he became conspicuous as the overturner of cabinets; he steadily refused to enter the government until 1906, and for 30 years France thought he was more of a destructive critic than a constructive statesman. On one occasion he overthrew Poincare's ministry which drew upon him that statesman's persistent hostility and during three years of war President Poincare would not call Clemenceau to the cabinet.

Clemenceau's extreme republicanism led him to oppose the French alliance with Russia and his fear of Germany led him to oppose a vigorous French colonial policy, for he remembered that in 1866 Maximilian's adventure in Mexico detained French troops abroad that were needed in Europe. At first a supporter of General Boulanger, Clemenceau turned against him realized that Boulangerism was dangerous to the existence of the Republic. His experience in the War of 1870 convinced him of Germany's enduring hostility, his native shrewdness and an almost chauvinistic patriotism prevented his accepting too literally the Socialist's creed of the brotherhood of man.

MARSHAL FOCH

GEORGES CLEMENCEAU

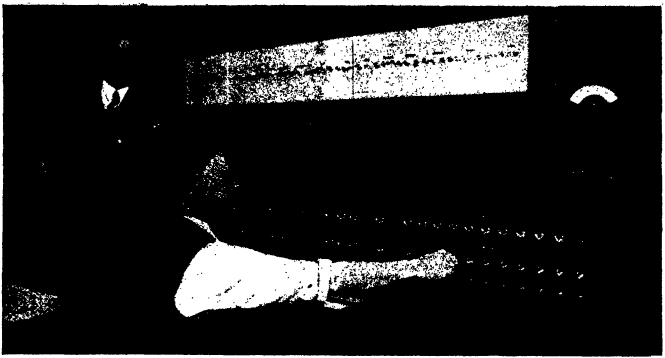
His hostility towards the Russian alliance and his indirect (but innocent) connection with a leading actor in the Panama Canal scandals cost him his seat in the Deputies in 1893, and for nine years thereafter he confined his activities to journalism. In 1902 he was elected to the Senate as a Socialist Radical, and in 1903 undertook the direction of the journal *L'Aurore*, which he founded after severing his connection with *La Justice*; both in the Senate and in his paper, he supported the Dreyfusards and actively advocated the separation of Church and State. From 1876 to 1906, a full 30 years, Clemenceau proved his abilities and courage in opposition; finally in March, 1906, he took office as Minister of the Interior, and to confound his critics, he showed ability and courage in defense of the government's powers by vigorously suppressing a miners' strike with the Army. He definitely broke with the Socialists in a celebrated speech answering an attack upon his procedure by Jaures, the leader of French socialism.

In the summer of 1906 Clemenceau became head of the Government, as President of the Council, and remained in power until the summer of 1909. During this period the entente with England was fostered and the old Republican found it much easier to carry on with democratic England than autocratic Russia, whom he tolerated largely because she was necessary to the security of France; still he would not permit any unnecessary indefiniteness on the part of the British Government and insisted upon Prime Minister Campbell-Bannerman giving assurance that under certain conditions the French could depend upon British military assistance on the Continent.

In 1907 Lord Bertie, British Ambassador, reported to his Government that the French were far from bellicose and were anxious to preserve peace with Germany. In 1908 Clemenceau summarized to Bertie the French view of Germany as follows: "France had suffered a crushing defeat in 1870-71 because she was entirely unprepared. The French Army was very different now from what it was then. The French desired peace in order to solve their pressing internal problems, but the French had confidence in themselves and Germany must not 'tread on French toes'."

In the Casablanca incident in 1908,

(*Please turn to page* 351)



Dispatcher operating control machine by means of which he flashes the signals and throws the switches that regulate the movement of trains over a 40-mile section of railroad. This efficient system makes possible the abolition of train orders

SIGNALS REPLACE TRAIN ORDERS

By **R. D. MOORE**
Signal Engineer, Southern Pacific Company

AN interesting innovation in train dispatching, by which telegraph offices are discontinued and the use of train orders entirely abolished, has been made by the Southern Pacific Company on its Stockton Division in California. This dispatching system is in operation between El Pinal and Brighton, a distance of 40 miles, and all train movements are electrically controlled by the dispatcher, including the setting of switches.

The section of country served by the railroad between the two points named, is a highly productive agricultural area, and the movement of perishable freight presents an unusual problem, in that the railroad is confronted with irregular peaks in the flow of traffic. At certain seasons of the year there is little or no movement. Later, the shipments increase steadily until October, when the year's peak is reached for a short time. During this heavy shipping season, each day's movement achieves a peak of a few hours, during which the problem of handling the movement expeditiously is a serious one.

The line over most of this stretch is single track, and the laying of a second track, which would have solved the problem, meant the expenditure of 2,500,000 dollars for a roadway that for a certain period of the year would not be required sufficiently to justify the expenditure. The system installed, which is known as the centralized traffic control system, obviated this expenditure and has increased the efficiency of the existing line to the point where the handling of a 30 percent increase in traffic is possible.

The control, or dispatching machine, located in the dispatcher's office, is provided with a chart of the track controlled. This chart is a diagram of the district and is equipped with small lights connected with the switch signals along the line, which automatically light up as trains pass over the various sections of track. By a glance at the chart, the dispatcher can see just what portions of the track are in use.

THERE are 11 sidings in the control, and these, with the two end switches, are provided with 24 electric switch machines. Suitable signals for governing train movements at switches, and a track circuit including the complete fouling limits of the switches and leads make up a group known as a "field station."

Each field station is reproduced on the control board in the dispatcher's office. Each panel of this board consists of a section of the track diagram representing one switch, a two-position switch lever, a three-position signal lever, a starting button, and a pen on an automatic graph, arranged in that order from top to bottom. Each panel also includes a luminous track indicator to repeat the condition of occupancy of the track circuit, and similar indicators to repeat the position of the switch and the signals.

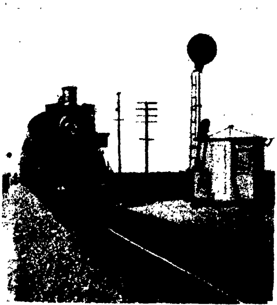
The control of traffic, with all necessary information for governing train movements, is thus centralized at this board, and any switch or signal can be operated by the dispatcher at any time.

The location and progress of trains are indicated visually by the track diagram indicators and are also permanently recorded automatically on a train graph which is located in a compartment below the level of the desk at the bottom of the control panels. It is a roll of specially-ruled paper, operated by a clock mechanism at three inches per hour, on which rest 24 recording pens, one for each switch point. When the train enters a track circuit the corresponding pen moves a short distance to the right, returning when the train leaves. The glass cover may be slid aside to permit the dispatcher to make any desired notations. The train-chart paper is in a continuous roll and it is the practice to tear it off daily at the midnight line and file it in lieu of the usual dispatchers' train sheets.

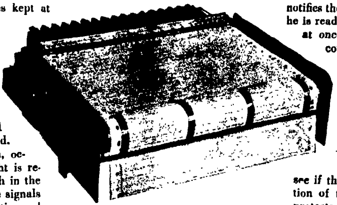
To change the position of a track switch or signal, the corresponding control levers are moved to a desired position and the push button is operated, causing the generation of a code in the line circuit, consisting of a series of circuit interruptions therein. When the field station units have responded completely, a code of similar nature is transmitted from the field station to the control panel, and causes the lights to indicate the new positions. If the levers are not moved, the pressing of the starting button enables the dispatcher to verify the indications without operating the field station units. Each code requires about six seconds to complete, so that several starting buttons may be operated in rapid succession and the codes will be sent out consecutively.

THE switches at ends of passing tracks are connected with, and operated by, electric motors. Power is furnished by storage batteries kept at a constant state of high efficiency by a trickle charge from a 110-volt power circuit.

All the switches are arranged for dual operation, so that, in case it becomes necessary, the electric control may be discontinued and the switch operated by hand. This, under normal operation, occurs only when a local freight is required to move back and forth in the process of switching cars. The signals between sidings are automatic and guide the trains much as they do elsewhere on the railroad. That is, should an engineer find a signal against him, he may proceed under standard automatic block signal rules to the next signal. The signals at the ends of the sidings are known as "absolute" signals. When an engineer finds one of these absolute signals in "stop" position, he must bring his train to a stop and telephone the dispatcher for instructions before proceeding. For this purpose, a telephone is placed near each absolute signal. The absolute signals govern the movement of trains into and out of sidings, and from one siding to the next. They are arranged to indicate whether the train should proceed on the main track or siding, and a clear absolute signal is all the authority required for a train to run to the next signal of this same classification.



When necessary to communicate with the dispatcher, the telephone in the little house is used



Device on dispatching machine which records train movement over the section

When it becomes necessary to move a switch by hand, the conductor must first secure authority from the dispatcher, which is done by using the telephone located at each dual-control switch. Before the dispatcher gives such permission, he places the signals at each end of the block in the stop position, to protect the train. He then notifies the conductor the limits within which he may opera [illegible] is allowed to do the work. When th switch is placed in the hand-throw posi tion, it automatically lights a signal [illegible] the dispatcher's board, giving him visual evidence that the switch is in use. The work completed, the conductor notifies the dispatcher by telephone that he is ready to proceed, and operation is at once restored to normal. If the conductor should find that he is unable to complete the switching in the allotted time, he must secure from the dispatcher an extension of time.

Thus, when authority is requested of the dispatcher to do hand switching, he first looks at his board to see if there are any trains in the section of track in question. If not, he protects each end of the section of track by placing signals in the stop position, and then gives the conductor authority to proceed.

THE advantages gained under the nev [illegible] ınifold. In the m ter of operating costs, a considerable saving is effected by reducing delays and greatly decreasing the number of stops.

Delays are reduced by the elimination of stops or slow speed for the delivery of train orders. A reduction of time consumed in meeting and passing trains is now possible, due to the great flexibility of the system. Under the old system, three stops were required when a train took a siding: one to open the switch, a second after the train had entered the siding, and a third to close the switch after the train was again out on the main line. Under the new system, two of these stops are eliminated, as the dispatcher opens and closes the switches. Frequently, the dispatcher is able to arrange such close meets that the third stop is also eliminated. More trains may also be operated by reason of the increased elasticity of movement with which traffic is handled.

Dual-control switch leading from the main line to a siding, and the switch [illegible] which is operated by electric motor or, when necessary, by hand

Copyright by Asahel Curt

Thousands of acres of water-covered land such as this in the United States and Canada are covered with wild rice, a valuable food grain indigenous to North America. These Indians are harvesting it in the primitive manner that is still used

WANTED: A WILD RICE HARVESTER

By LAWRENCE W. PEDROSE

LONG before the advent of the white explorers and the resultant civilization which introduced cereals in printed packages and bags, the Chippewa Indians of the central west harvested wild rice on the prairies, and made cakes and breads which have never been excelled by modern millers and bake shops, and which are in these modern times considered equal to foods made from the finest domestic grains. Singularly, the aborigines' method of harvesting wild rice has never been improved upon, and the colorful industry is carried on by a picturesque people in the same manner their forefathers conducted it, except that now it has a commercial aspect in that the grain is widely used in dietetics and for purposes of propagation. The growing demand for wild rice in recent years has resulted in experiments being made to increase the supply, and attempts at domestic cultivation on a comparatively small scale are proving successful.

Wild rice, also known as Canada rice, is indigenous to the North American continent. It is native to prairie marshes and is found in vast areas from the Great Lakes to the Rocky Mountains and in Northern Canada and Alaska. It is to the wild rice marshes that the migrating waterfowl common to North America go when they fly north in the spring. There they breed and rear their young, remaining until the approach of winter has sealed the lakes with ice and cut off their food supply.

WILD rice has qualities said to be found combined in no other grain. High caloric content and the principal vitamins are claimed for it. It is easily digested and valued for its medicinal properties. Hospitals use it extensively in the treatment of dyspeptic disorders, and it also is popular as a companion dish with almost any kind of wild game. But despite the fact that the demand exceeds the supply, and the cost has risen to a dollar or more a pound, the character of the rice fields is such that it discourages improvement on the primitive and more or less efficient harvesting methods of the Indians. However, a fruitful field for experimentation is here, and it offers possibilities of establishing a domestic industry of great economic value.

When the early fur traders extended their activities northward through the then little-known Louisiana Territory and entered the Sioux, the Chippewa, and the Cree nations, they found the Indians using wild rice in much the same manner as the coastal and southern Indians used maize. The rice fields were merely shallow lakes and seemed almost limitless in extent. Harvesting was simple. A light canoe was poled through the fields, a squaw seated in the stern with a birch bark basket in front of her. In her hands she held two short clubs. As the canoe made a lane through the rice, she hooked sheaves of rice-stalks with one club and bent the heads over the basket while with the other she struck the grain from the heads with a quick, sharp blow. The method, while painstakingly slow, was productive, and a deft worker could harvest several hundred pounds in a day.

The next step was to place the grain in a wooden bowl and bruise it with the ends of poles to remove the hulls. Relieved of chaff, the grain could then be stored in any convenient container and kept indefinitely if stored in a dry place. Today practically the same method of gathering the wild rice is used.

THE harvest season is short. The field is a lake varying from one to five feet in depth. New rice shoots appear as grass on the bottom of the lake as soon as the ice thaws in the spring. As summer draws near, the lake shrinks, and the rice sprouts reach up to the surface. By August the stems have risen several feet above the water and the head begins to form. The grain ripens in a fortnight to three weeks, and nature protects it by causing it to fall while still green so that it will sink to the lake bottom and become seed. After the grain falls, the stalks wither and sink to provide nourishment for the next crop. It is during the short ripe period that harvesting must be done.

If the grain is very ripe, gathering of the grain is a delicate procedure. If the harvesters procrastinate, they may find that a sharp wind has stripped the field of its grain overnight. Then it can be secured only by the wild waterfowl that dive to the bottom and pluck it from the mud. Ordinarily only the older and more experienced Indians, especially the squaws, do the gathering, and the threshing is left to the young people of the tribe. Production is figured at 12 to 15 bushels per boat a day, and during the harvest season this work is pressed from daybreak to dusk almost without halt—a period of 18 hours or more. To a white man the harvesting of a bushel of grain per hour would be tedious labor, but to the Indian, with his vast patience, time means nothing.

A number of physical obstacles stand in the way of applying science to the wild rice industry. By the Indian method, only a fraction of the grain can be garnered. Could a machine be perfected to take the place of the canoe and hand-beater, production would be increased many fold. But the operation is a very exacting one because of the delicate character of the plant, and because of nature's way of assuring its perpetuation. Successive steps in the harvest, such as separating the grain and the chaff, can be accomplished by mechanical methods of removing the stubborn hulls.

In the last few years hundreds of duck preserves have been established in practically all parts of the country by sportsmen's associations and game conservation clubs. Many of them have successfully propagated wild rice, and the grain, when once started, has been found to be very hardy and adapted to any temperate climate.

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Chippewa Indians threshing the grain by pounding it with the ends of poles to remove the chaff. Quaint birch bark baskets used in the harvesting are shown

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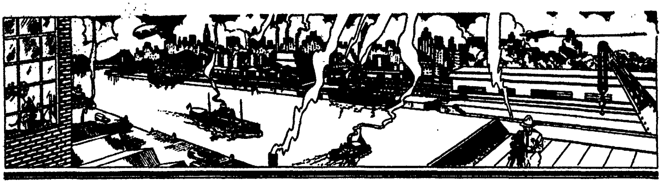
No machinery is used here. An Indian harvesting wild rice as explained in the text

Oriental rice is adaptable only to tropical and semi-tropical climates, but native wild rice, once successfully seeded, grows well in northern climes and propagates itself as luxuriously as weeds. The grain, however, loses its fertility if it has been dried. When it is to be used for purposes of propagation, it must be stored in water immediately after harvesting. When it is shipped, it must be placed in water-absorbing material to protect the germ. When kept moist it retains its fertility until the following spring. Packed in wet moss and sealed in a watertight container, it can be shipped anywhere.

THE Indians use the straw of the wild rice for many purposes, and there is a possibility in developing this by-product. Hundreds of thousands of tons of the straw could be obtained on the central and northern prairies and in Alaska. The Chippewas take the part of the straw between the last joint and the head, and weave it into hats, baskets, mats, and other useful articles. It is said that the straw is comparable to the product imported from South America and Europe, is easily bleached, and is very durable as well as extremely light in weight. In experimental work a high grade of paper has been made from it, equaling the best domestic rice straw papers manufactured in the Orient.

Knowing the facts concerning the excellent dietetic qualities of wild rice and the possibilities of utilizing its straw, one can readily imagine seeing, in the future, great lakes or marshes of the growing grain being harvested by special machinery on chugging motor boats. While the incentive to development of such machinery may be lacking now, man's persistent search for new foods in commercial quantity, for new methods of utilization of the earth's waste spaces, and for valuable by-products may turn wild rice into a valuable commodity.



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

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Lightning, Benefactor of Mankind

"SCURRY to the cellar and jump into the furnace if you want to be absolutely safe during a severe thunder storm," says K. B. McEachron, research engineer in the lightning arrester engineering department of the General Electric Company at Pittsfield, Massachusetts. "This is, in effect, a solid iron room perfectly grounded, which would be the ideal safe place for a human being to be. Since this is impossible, however, we should simply carry on, if we are in the house, with the ordinary routine but should remain away from overhead wires, keep away from the radio, not take a bath, be chary about using the telephone, and keep away from metal objects of appreciable size. Then we are in little danger. Some of the old ideas about protection from lightning are really sound after all."

Bolt of lightning near a large radio tower showing clearly how lightning can be blown by gusts of wind

Lightning is one of the greatest benefactors of mankind despite its reputation for being a terrible enemy, Mr. McEachron points out. "It produces, free of charge, about 100,000,000 tons of fixed nitrogen yearly over the earth's surface. It acts in this capacity the same as heavy electric discharges do in nitrogen fixation plants. The only difference is that the bolt of lightning coming down through the air, which is approximately four fifths nitrogen and one fifth oxygen, breaks down the chemical constituency of the air and deposits fixed nitrogen on the soil, all at no cost to the farmer. In manufacturing nitrogen, electric sparks of from 15 to 20 feet in length are used. In nature, lightning provides sparks perhaps 2000 or more feet in length, thus producing immense quantities of this absolutely essential chemical in agriculture. Hence it is that we find lightning as a great benefactor, although sometimes it does jump about wild and loose, causing considerable property damage and even loss of human life.

One old idea about protection from lightning is that it is not wise to stand in an open doorway or near an open window during a lightning storm. It has been proved in several different ways, says Mr. McEachron, that lightning can be blown and moved from its path by the wind. For that reason it is not wise to stand in an open doorway or near an open window, for if lightning should strike and be blown by the wind in the direction of the person standing, it might prove fatal. Such instances, however, are rare.

"It is a good idea to keep away from chimneys or open fire-places during an electrical storm," Mr. McEachron continues. "One of the poorest places to be during a lightning storm is in the water. If you are swimming, bathing or enjoying any water sport during a lightning storm, you had better paddle ashore and watch the storm from a safe distance.

"In an automobile one is relatively safe, although not a bit more, and possibly even less so, than when walking on the ground."

* * *

New Paint Resists Corrosion

FOR resistance to mineral and organic acids, mild alkalis, alcohol, benzol, gasoline, acetylene, oils, greases, soaps, steam, sunlight, and very high temperatures, a newly developed coating material is being sold under the name of "Rubalt G." This coating, used on metallic or other surfaces, forms a very hard cement-like surface with a rough gray finish. It is adhesive but not elastic, and is air drying. In being applied, it is maintained at the proper thickness by adding a small quantity of water. It is flowed on thickly in two coats, and after the second coat is dry, a coat of hardening compound is applied.—*A. E. B.*

* * *

Eruptions from Women's Hats

AGAIN and again skin disturbances are reported which are related to something peculiar about feminine costumes. German observers have reported irritation of the skin of a patient associated with "V" necks in winter. The rolling of stockings brought about unusual appearances of the skin of the knees, and the appearance of varicose veins due to constriction of the circulation. Furs dyed with paraphenylenediamine have produced eruptions on the skin. Now Professor Frei in Germany insists that skin eruptions are occurring on the heads of women because of the present style of hats.

The recent type of eruption is not asso-

Do hogs perhaps point the way to one satisfactory solution of the wheat surplus problem? This fine drove of hogs, raised on the farm of John J. R. Classen, near Beatrice, Nebraska, was wheat-fed; and, according to Mr. Classen, yielded a return of $1.15 per bushel of ciated with any special hair tonics or hair dyes. It is more like the form of eruptions which were found on the heads of men due to the artificial leather used in the sweatbands of hats. In the four cases seen by Professor Frei, all the women had worn tight fitting hats now the vogue, and the irritations of the scalp were found at the points on the head against which the hats rubbed. Professor Frei thinks it possible that the women concerned were hypersensitive to dye substances used in making black felt, but attributes their skin eruptions also to the fact that the tightly-fitting hats bring the dangerous substance in close contact with the scalp, rubbing the scalp vigorously and producing heat and perspiration. —*M. F.*

Traffic Snarls Irk Old Algiers; Plan Subway

FINDING that apparently even the lure of mystic Africa loses its glamor in traffic congestion, the old city of Algiers plans a subway for relief.

Claiming that picturesque natives and their camels plodding through the bazaar-lined streets would appeal more to tourists that would a traffic jam too familiar to the visitors at home, a commission recommends that this city, now boasting 350,000 population, should build a three-mile subway. The plan calls for completion within 10 years at an expenditure of 20,000,000 dollars.

Have You Had Your Mercury Today?

Little Willie, from the mirror,
Licked the mercury all off;
Thinking in his childish error
It would cure the whooping cough.
At the funeral, Willie's uncle
Sadly said to Mrs. Brown:
"'Twas a chilly day for Willie
When the mercury went down!"

Whenever the toxic properties of quicksilver are mentioned, this jingle inevitably comes to mind. Yet here comes a German chemist with the announcement that many perfectly good foods contain traces of mercury.

A few years ago, a storm of protest was elicited from dentists by the publication of a report that small, but harmful quantities of mercury are released to the body by the ordinary amalgam tooth fillings. Doctor Borinski, director of the Chemical Institute of the Principal Health Office of the City of Berlin, now maintains in the *Berliner Gesellschaft für Öffentliche Gesundheitspflege* on the basis of many years' investigation of the mercury research position established at the institute, that almost all our foods contain mercury. Mercury was also found in persons who had never had a tooth filling and had never come in contact with mercury, and even in sucklings and the new born. The mercury found in persons having amalgam tooth fillings might not originate in the dental fillings, but from food itself, and this naturally occurring mercury cannot be injurious to the health.—*A. E. B.*

Vanadium in Shatterproof Glass

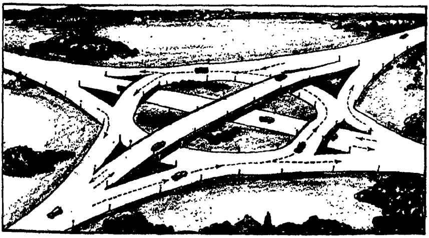
THE physical properties—such as refractivity, absorption of heat rays and ultra-violet rays, transmission of luminous rays, and reduction of glare—imparted by the rare metals to glass are dealt with in an article in a recent issue of the *Vancoram Review*, the organ of the Vanadium Corporation of America.

Most of these metals give decided colors to the glass, but a few, such as cerium and vanadium, under proper conditions, produce colorless glass and, it is predicted, it will be these colorless glasses which will receive added attention in the future. Cerium nitrate is generally used for the addition of cerium to glass mixes and occasionally cerium borate and ceric oxide, the proportion of metal varying from 1.0 to 7.5 percent. Cerium is of value in cutting off the ultra-violet rays; the glasses are very slightly colored, and allow nearly all of the luminous rays to pass. The heat absorption is about 30 percent.

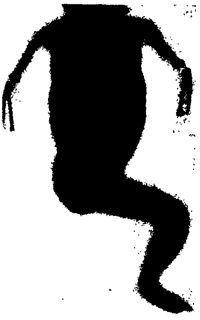
Neodymium and praseodymium, when used in the proper combination, produce a neutral grey. By variation of the proportions, the color varies from a light ruby color to greyish-blue and brown-green. They have a high absorption of the ultra-violet and infra-red rays.

Uranium in glass produces a brown-to-yellow color with a greenish opalescence. The opacity for ultra-violet light increases as the glass is richer in metal.

Vanadium glass has the bright appearance and high transmission properties of ordinary glass but it filters out ultra-violet rays. It is therefore used in the glass used in the manufacture of non-shatterable glass which is made by cementing two glass sheets to an intermediate sheet of celluloid. The ultra-violet rays passing through ordinary glass cause deterioration of the celluloid, which may be quite rapid where the glass is used on ships or automobiles in tropical or very sunny regions.—*A. E. B.*



Becoming interested in the clover-leaf design of a highway crossing which was the subject of our cover painting for February, Dr. Wm. T. M. Forbes, of the New York State College of Agriculture at Cornell University, worked out the above design which our artist has sketched. Dr. Forbes said in submitting it: "For a given limited turning radius, it would take up far less space than the clover-leaf model, and would be just as safe since the intersections at grade are of traffic going in practically the same direction." Possibly Dr. Forbes' design will prove practicable in places where space is at a premium. He does not claim, it will be noted, that it would otherwise be superior to the clover-leaf arrangement



X ray of a baby who was born with a perfect left leg but no right leg

Congenital Absence of the Right Leg

AMONG the saddest of deformities are th[illegible] cases in which children are born [illegible] me of the four limbs which constitute the normal equipment of the average human being. In a case just described by Dr. F. J. Barkman, an infant born to a young mother as her first child had a complete absence of the right leg at birth. Apparently some process occurring about the fifth week of embryonic life had interfered with the development of the right limb, since it was absent completely. A careful search of medical records by Doctor Barkman revealed the fact that there have been only four previously reported cases of this kind, which would indicate the extreme rarity of the condition.—*M. F.*

Mucin and the Stomach

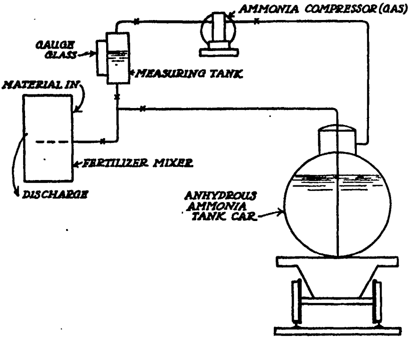
WHEN a person chews food vigorously a considerable amount of mucous material is combined with the food. Mucous secreting glands are found all along the gastro-intestinal tract. It occurred to Dr.

S. J. Fogelson that mucus might be an ideal substance to restrain the acidity of the stomach, particularly in cases of gastric ulcer or ulcer of the intestines. Mucus combines readily with acid. Normally it acts as a protective, soothing, and lubricating substance. So far as is known, the presence of mucus does not bring about any chemical disturbances in the body.

A preparation was made of gastric mucin by treating chemically the lining of a hog's stomach. Tests were then made on the effects of this mucin on animals to determine the manner in which it would affect digestion, and also the extent to which it would control the acidity of the gastric secretions. After the usual preliminary tests on animals the preparation was tested on 12 patients with typical histories of gastric and duodenal ulcers. It was found that gastric mucin has the ability to combine with the acid of the stomach so that two ounces of mucin placed in the stomach of a dog was more than sufficient to combine with the acid secreted in response to the irritation following the injection of histamine. When half an ounce of mucin was mixed with a half pound of meat and fed to the dog, free acid did not appear in the dog's stomach for some five to seven hours.

Several patients who were given the mucin stated that they were freed of their symptoms for varying periods so that it has been determined to carry the investigations further in order to determine the exact value of such a method in human cases. —*M. F.*

Above: The rotary mixer may be seen beyond the motor. At the top of steps is the measuring tank into which the ammonia is pumped and from which it is discharged into the mixer. Fertilizer from the mixer is ready for bagging. *At right:* Ammonia compressor in a fertilizer plant in Indiana. *Below:* The simplest method of fertilizer ammoniation—direct from the tank car

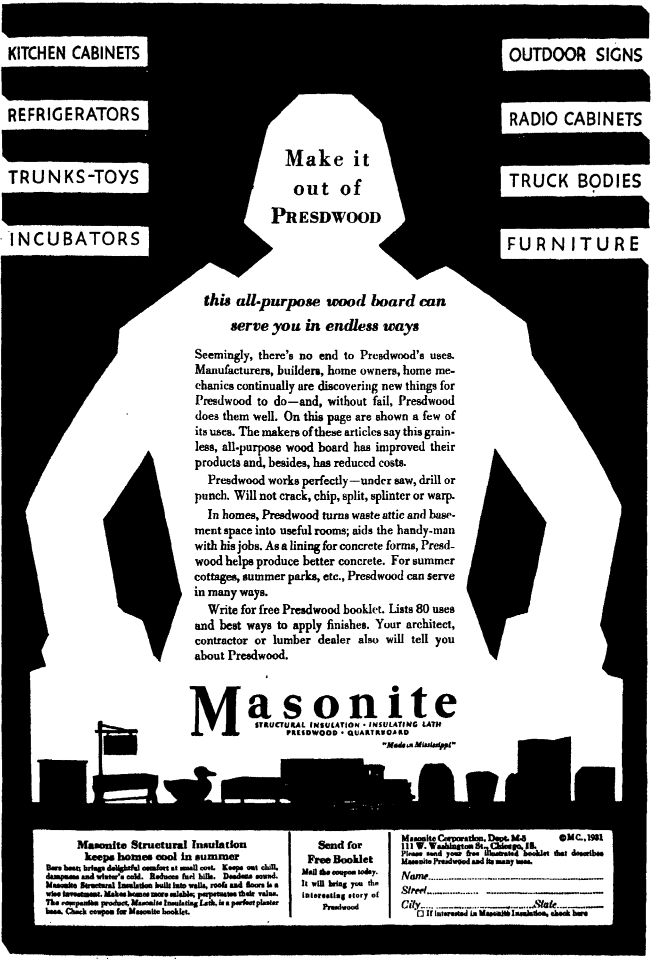


Fertilizer Nitrogen from Synthetic Ammonia

FOR over ten years, Congress has been trying to decide what to do with the nitrate plants built during the War, at Muscle Shoals. It has been evident that if the plants were operated, the nitrate so produced would be available for fertilizers to replace the natural sodium nitrate imported from Chile. Fortunately, chemical technology moves more swiftly than Congress and it begins to appear now that by the time a decision is reached on the Muscle Shoals question, sodium nitrate will have been superseded by ammonia as the nitrogen-bearing constituent of artificial fertilizer. This change is due to the recent development of a process for the synthesis of ammonia from the nitrogen of the air, making anhydrous ammonia available at commercial prices.

According to F. J. Keenen in a recent issue of the *DuPont Magazine*, the production of artificial fertilizer in this country last year amounted to eight million tons containing approximately 800,000 tons of phosphate and 300,000 tons each of nitrogen and potash. Natural-occurring Chilean nitrate is being rapidly replaced by nitrogen obtained from the air as ammonia. Anhydrous ammonia is 82 percent nitrogen and is therefore the most concentrated form of fixed nitrogen known, which means low transportation costs.

About half the fertilizer tonnage produced in this country is known as superphosphate, produced by the action of sulfuric acid on phosphate rock. Because of its acid properties, superphosphate absorbs ammonia and combines chemically with it rapidly up to 5 or 6 percent ammonia. The first reaction occurring when ammonia is added to superphosphate is the neutralization of the free acid present. This eliminates the rotting action of the free acid on fertilizer bags, heretofore a nuisance. Also the tendency to cake is to a great extent removed. Ammonia further acts upon the superphosphate to produce dicalcium phosphate, mono-ammonium phosphate, ammonium sulfate and a new form of phosphate which is called "precipitated tricalcium phosphate." The exact chemical composition of this new material is not yet known but it is almost identical in behavior with bone meal phosphate. The fertilizing value of these materials is very high, because all are water soluble and



KITCHEN CABINETS

REFRIGERATORS

TRUNKS-TOYS

INCUBATORS

OUTDOOR SIGNS

RADIO CABINETS

TRUCK BODIES

FURNITURE

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this all-purpose wood board can serve you in endless ways

Seemingly, there's no end to Presdwood's uses. Manufacturers, builders, home owners, home mechanics continually are discovering new things for Presdwood to do—and, without fail, Presdwood does them well. On this page are shown a few of its uses. The makers of these articles say this grainless, all-purpose wood board has improved their products and, besides, has reduced costs.

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hence are readily assimilable by plants.

The technique of adding nitrogen to commercial fertilizers in this new convenient form is very simple. Anhydrous ammonia is pumped from a tank-car through a measuring tank and thence into a mixer where the ammonia is thoroughly stirred into the superphosphate. Since the fertilizer manufacturers mix their materials in the same equipment, anyway, the application of ammonia does not necessitate an extra handling of the materials and an improved plant food is thus produced at no extra cost.—*A. E. B.*

Overhauled Bus Motors "Broken In" By City Gas

MOTORS overhauled in the garage of a motor bus operator in Chicago are "broken in" ready for high-speed highway operation by running them on manufactured gas until danger of over-heating and other damage is past.

Little heat, no carbon, no noise, and slow speed are the benefits claimed for gas over gasoline for limbering up new or tight motors.

Retail automobile dealers are watching the process carefully, it is reported, as it offers the possibility of selling cars ready for the road, without the tedium of many miles of slow driving for the new owner.

Bees Travel 40,000 Miles To Make Pound Of Honey

A 16-OUNCE jar of honey, no matter how good, is hardly worth a 40,000-mile journey. Yet that is the total distance traveled by many bees to provide the nectar necessary for just that amount of honey, according to C. B. Gooderham, apiarist of the Dominion Government.

Mr. Gooderham has figured it out mathematically. A honey bee weighs approximately only 1/5000th of a pound, and during the honey flow on each trip she carries approximately half her own weight of nectar. It therefore requires approximately 10,000 flights to gather a pound of nectar. Furthermore, Mr. Goederham states, nectar loses about half its weight through evaporation.

Taking all this into consideration, as well as the fact that each return flight averages about two miles, it is figured that bees have traveled at least 40,000 miles to provide 16 ounces of honey.

So it is no wonder that the little honey bee unlucky enough to be born in summer lives but a brief six weeks. Bees born after this summer rush have an average life of seven months.—*Science Service.*

An X Ray of a Passenger Airplane

THE Handley Page 42, equipped with four supercharged Bristol engines, has a speed of nearly 130 miles an hour. The stalling speed is 50 miles an hour. It can fly on any three engines at normal power with full load and can climb to 6000 feet under these conditions.

A study of the artist's brilliant drawing is most instructive. One can almost imagine oneself inside this comfortable looking craft.

The pilot's cockpit is at the very bow of the ship, so that vision is uninterrupted in all directions. Immediately behind the pilot is the wireless cabin; beneath the cabin is suspended the wireless antenna. The pilot can keep in constant touch with ground organizations, sending messages as well as receiving them.

The forward cabin looks quite comfortable and is well ahead of all the engines. Windows are not relied upon for ventilation: the drawing shows ventilating pipes, with the suction of the propellers assisting ventilation. A corridor leads past the lavatories into a cocktail bar. The English are, apparently, not at all afraid of smoking on board a plane, and hence we find a smoking cabin.

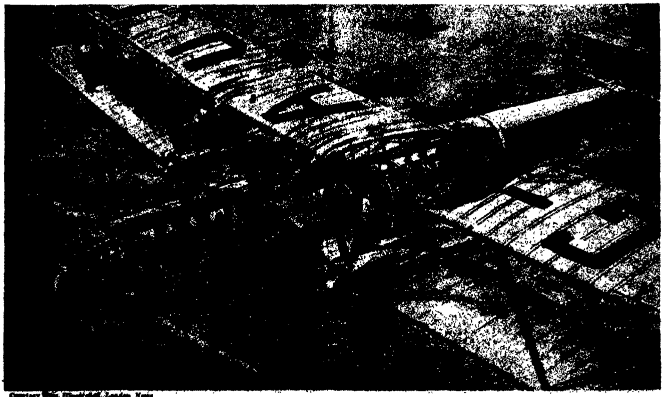
It will be noted that the tail is of biplane construction which is quite logical for a ship of this size. It will be noted also that the balance for the rudders is in the form of a separate auxiliary surface.

The span of this enormous plane is 130 feet. In spite of the great size of the biplane structure, all wires have been avoided and tubular interplane struts of steel form the trussing of the biplane. While such trussing means a little sacrifice in efficiency and weight, the elimination of wires lessens maintenance troubles.—*A. K.*

Gliding in a High School

WE have always been strong exponents of the argument that gliding was a fit activity for the public school. Now we read in the magazine of the Negaunee, Michigan, High School, a series of articles on gliding, contributed by the Aviation Club of this school. The boys built their own glider, tested it themselves and had a wonderful time.

Here is what the boys write about it: "The construction of a glider was begun. There were ready-made gliders in the market selling at around 500 dollars. Buying one of these would have enabled us to fly sooner probably but would have deprived us of the experience of building a ship. The construction is very much the same as that of an airplane with the motor left out. Then there is the possibility of mounting a motor in the glider after one has become skillful at handling it. The price of the ready-made gliders made the purchase of one impossible for us anyway, so we went to work in earnest. Every spare minute, every day, and nearly every night the boys plugged away. None of us ever having had any experience, every minor detail had to



Courtesy The Illustrated London News

Cut-away, or "X-ray" drawing of the passenger airplane described above be studied carefully and the best plan decided on.

"I cannot begin to enumerate the difficulties and puzzling questions that arose. In the first place the materials of which an airplane or glider is constructed must be very carefully selected. After it is decided what materials are needed it is not always easy to find where you can purchase them. After they are obtained the problem arises of cutting and fitting the parts into place. One illustration may bring out the magnitude of this last mentioned job. In the wing alone there are over 2000 pieces of wood. Each one of these pieces must be cut to exact size and glued into place. I cannot take time to write about the metal fittings, the wire parts, the cloth, the dope, and the paint entering into the construction of the ailerons, the elevators, the stabilizer, the rudder, the fuselage, and the control stick.

"Not much was done during summer vacation but work began in earnest again upon the opening of school in September. As the Christmas vacation appeared, the glider neared completion. It seemed as if we never would get it finished but on the Saturday night before Christmas about midnight the last work was completed. The seat was placed at that time and our ship was ready to be taken out and assembled. The next morning at daybreak the boys were all on hand and this work began. About three hours were spent assembling it on the High School lawn. Then the glider was lifted over the fence and towed to the Maas Mine aviation field. That afternoon we made our first flights with a great deal of care indeed and by evening were pretty well satisfied that everything was well with our glider.

"Every member has gained considerable skill at flying. Rudy has been in the air more than an hour and flown more than 50 miles. Lawrence ('Col. Lindbergh') and Oscar have done almost as well if not just as well. This has been done without a bump or bruise. I truly believe that learning to fly a glider, under proper supervision, is no more dangerous than learning to ride a bicycle. Every one of the boys will agree that he has been fully repaid many times over for all the hard work. Besides this he has the knowledge gained in the construction of the glider. We also have the glider with the heaps of fun and opportunities which it is sure to afford us in the future."

This is the most convincing proof of the possibility of glider activities in the schools that we have seen in a long time.—*A. K.*

The Loening Submarine Plane

MORE than four years back, in the November 1926 issue of the SCIENTIFIC AMERICAN, we described a little biplane with an over-all wing spread of only 20 feet and equipped with a three-cylinder Wright air-cooled engine of only 60 horsepower. This craft was capable of a speed of 80 miles an hour. As a result of very careful design, it could be packed in a few minutes into a tube placed on the deck of a submarine; a few minutes sufficed for disassembly, nine minutes for complete assembly. To make a getaway, the deck of the submarine was kept flush with the level of the sea.

As far as assembly and disassembly and

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Iron Fireman burns the smaller sizes of coal which cost less per ton—and it burns less coal. A national survey in business installations shows average yearly fuel savings of 31.62 per cent—equal to an annual return of 39.44 per cent on the investment in Iron Fireman. In homes, annual fuel savings averaged 45.61 per cent. You should have the same experience when you replace hand-firing, or other types of automatic fuel, with Iron Fireman Automatic Coal Burner.

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"Iron Fireman has saved us 21 per cent on the price of coal and 18 per cent on tonnage—a total of 39 per cent in fuel costs."

IRON FIREMAN

THE MACHINE THAT MADE COAL AN AUTOMATIC FUEL

The Loening flying boat can be assembled or dismantled in three minutes

flying in calm weather were concerned, the little biplane was quite successful. It was too small however, to be perfectly airworthy in the all-weather service required by the Navy.

Now Grover Loening, the well-known aeronautical engineer, has designed a much larger craft which is reported as being entirely satisfactory to the Navy Department. The Assistant Secretary of the Navy for Aeronautics states that the Navy is planning to equip each of its submarines with at least one plane of this type.

While this is much bigger than the small two-seater hydroplane used in 1926, nevertheless the Loening flying boat will still be capable of stowage in a tube, presumably still to be mounted on top of the submarine.

The Loening submarine flying boat is expected to become a valuable plane for naval patrol duty. It will also be able to carry a certain amount of armament. Owing to its larger size, it is really airworthy and its high-prowed metal hull makes for seaworthiness in a choppy sea.

In all its struts, tail surfaces and engine nacelle, bolts and cotter pins are used so as to provide fast assembly or disassembly. The engine is mounted on hinged struts just behind the pilot's seat. Some of the engine nacelle struts extend at an angle midway along the wing. By slipping a few bolts, the whole engine nacelle folds back against the hull. The wing pontoons can be similarly demounted. The tail surfaces also lend themselves to a similar process.

The 36-foot monoplane, equipped with a 100-horsepower engine, shrinks into its tube in a very few minutes.

While further details for the time being are being held secret by the Navy, it is known that great ingenuity has been used by Grover Loening in achieving these objectives and his plans were accepted by the Navy in the face of severe competition by other constructors.—*A. K.*

Ski-Flying

SKIING is, in itself, an exciting and wonderful sport, but a young Viennese engineer, Joseph Krupka, has improved on its thrills and possibilities. He has constructed a pair of light wings which can be readily attached to a man's shoulders, yet can be easily folded, placed in a cover, and transported like a folding boat.

The procedure is to start off on skiis alone, then to spread out the wings as the speed increases. Finally the man's body leaves the ground and his legs stretch more and more backwards, until his body and the wings alike are in the same horizontal line. In this position, Krupka has been able to fly to a height of 15 yards above the ground.

It is, apparently, quite easy to brake the flight and to make a comfortable landing. With the wings pivotable at the will of the flier, the new device has bird-like maneuverability in the air.

We should imagine this will add to both the amusement and excitement of skiing to a high degree.—*A. K.*

Aircraft Radio Communication

ONE of the most important aids to the safety of airplane transportation is constant communication between pilot and the ground at all times.

Eugene Sibley of the Airways Division of the Department of Commerce, in a paper presented before the American Institute of Electrical Engineers, summarizes in admirable style the status of aircraft radio communication today. We present below salient points taken from Mr. Sibley's paper.

The Department of Commerce will soon be able to provide complete weather reports and give radio direction to all aircraft equipped with a simple type of radio receiver.

The equipment of a standard radio station of the Airways Division consists of a 2-kilowatt intermediate-frequency transmitter for broadcasting the weather; in addition, a 500-watt high-frequency transmitter is used for point-to-point communication.

Radio stations are also being equipped with a directional radio beacon which may give either a visual or an aural signal to the pilot.

Sometimes the radio beacon is called the "radio range." The radio range has the advantage of serving the pilot throughout the 24-hour day and, unlike lighting aids to navigation, it is not affected by thick ather. The most important feature of the range is that it serves as a homing e, *making it possible to fly to the ex-* cation of the beacon, thereby locating the landing field at which the radio range has been established. A number of landings under conditions of fog and thick weather have already been made, in cases of emergency, by aid of the radio beacon, and trips that would *otherwise* have been impossible, have been completed in safety.

Ski-flying down a mountainside

The antenna system of the radio range consists of two crossed loops erected at right angles to each other and supported by poles. In a small building at the foot of the center of the antenna pole, a radio transmitter is located, together with other apparatus required for the operation of the beacon. The radio range sends a characteristic signal

New radio direction finder in a Transcontinental Western Air Express plane alternately from the loops, sending the letters "A" and "N." Interlocked, these form the letter "T" when the signals are of even strength and the plane is on the right course.

The radio receiver required on board aircraft consists of the receiver, A and B batteries, earphones, and antenna. The re-

ceiving equipment weighs approximately 30 pounds and has a frequency range from 200 to 400 kilocycles. The antenna consists mlined wooden mast which extends about six feet above the fuselage d to the rear of the bin or behind the pilot, with the receiver ctly beneath it. An insulated tends through the length of the mast, must be insulated from the element reduce rain

Two-way communication between aircraft and ground is now provided for all interstate operation where passengers are carried. In such cases, the aircraft is equipped with a radio transmitter.

The radio beacon is somewhat expensive to install and maintain, but a new radio direction finder has been successfully tested by Transcontinental Western Air Express hich avoids this expense. This new radio n finder with any commercial broadcasting station. The device weighs only 10 pounds and consists of a receiver, a loop antenna, and a small meter. This device was recently used on the 400-mile run from Los Angeles to San Francisco. The pilot found that the needle of the meter pointed to dead center when he was on the proper course and wavered to one side when he deviated from it. When he arrived directly over the station, the needle vibrated.—*A. K.*

New Diesel Racer Will Run 1200 Miles Without Refueling

ADAPTATION of the Diesel engine to a racing car by C. L. Cummins August S. Duesenberg, the racer and manufacturer, has increased engineering interest in the 1931 Indianapolis Motor Speedway 500-mile race to be run on Memorial Day.

The new car is nearly twice as large as the conventional gasoline racer. It is said to carry sufficient crude oil fuel to run nonstop at 100 miles an hour for 1200 miles. This would give the new car the advantage of not having to stop to refuel, which is estimated to be the equivalent of a five mile start on the rest of the field.

The car cost 15,000 dollars. It is 16½ feet long and nearly four feet high. It is four-cylindered with a piston displacement of 366 cubic inches.

No ignition system is used in the new car, the heat of compression serving to fire

How you can Quit Work at 55 and retire on an income of $200 *a Month*

THE greatest thrill of my life occurred few months ago. I re- ved my first Guaranteed Income check. that those checks will come to me every month for life.

'I'm taking a vacation that will last a lifetime. Happy! I've never been so happy. No work. No worries. Nothing to do but fish and play golf and travel.

"I sleep like a baby. Appetite excellent. Blood pressure normal. The doctor says *there is no reason why I shouldn't live to be a hundred.*"

This story is typical of those who have guaranteed Life Incomes. The Phoenix Mutual Retirement Income Plan makes it possible for you to retire at 55, 60, or 65. You may provide for yourself a Monthly Income for life of $100, $200, $300, or more.

How the Plan Works

Here is what a $200 a Month Retirement Income Plan, payable at age 55, will do for you:

It guarantees when you are 55, a Monthly Income for life of $200, which assures a return of $20,000 and perhaps two or three times that amount, depending on how long you live. Or if you prefer, a Cash Settlement of $30,200.

It guarantees upon death from any cause before age 55, a Cash Payment to your beneficiary of $20,000. Or a Monthly Income for life.

It guarantees upon death from accidental means before age 55, Cash Payment to your beneficiary of $40,000. Or double the Monthly Income for life

It guarantees in event of permanent total disability before age 55, Monthly Income of $200.

There are other benefits which may be included in this Plan. A guaranteed retirement income for your wife. Money to send your children to college. Money for emergencies. Money to leave your home free of debt. Money for other needs. Plans for women are also available.

One advantage of this Plan is that it does not have to be paid for all at once. It is usually paid for in installments spread over a period of 20 years or more. Naturally this makes the individual installments comparatively small.

Another advantage of the Plan is that it goes into operation the minute you pay your first installment. As you continue to invest, *the fulfillment of your life plans is guaranteed.*

Send for the Facts

We should like to send you an interesting 28-page book called "How to Get the Things You Want," which tells all about the Retirement Income Plan and how it can be exactly suited to your own special needs. No cost. No obligation. Send for your copy today.

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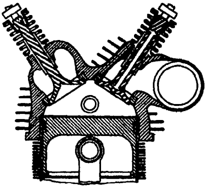
the fuel. The fuel tank holds 47 gallons of crude oil and the radiator has a capacity of 42 quarts of water. Mileage is 40 miles to the gallon under ordinary driving conditions. At a speed of 100 miles an hour, the mileage is about 25 miles to the gallon. When tested for speed at Daytona Beach, Florida, the car made 100.772 miles per hour under A.A.A. timing.

Diesel engines offer advantages in strength and economy of fuel and consequently have been adapted to many uses in the past. This is thought to be the first time a Diesel engine has been tried in a racing car, however, though they have been used in airplanes.



Mr. Cummins, who lives at Columbus, Indiana, has a long record of developing Diesel engines to new uses and has written a number of papers on the subject. His co-worker, Mr. Duesenberg, is a well-known racing figure.—*Science Service.*

An Internally Cooled Exhaust Valve

IN paper presented before the Society of Automotive Engineers, Manse M. Harris describes an interesting and novel form of exhaust valve.

Exhaust valves have a hard time of it. Besides the repeated shock, they have to withstand the presence of sulfuric acid in the exhaust and above all, enormous temperatures rising often as high as 1700 degrees, Fahrenheit. The design of the valve and the selection of material are, therefore, very difficult problems and valve troubles are still a little too frequent in aircraft engines.

Many ideas have been tried out for cooling of valves. Internal salt filling of the valve and valve rod has been successful; salt filling, however, is expensive and cannot be used in many engines.

In the Friedl valve described by Mr. Harris, internal air-cooling has been applied with very successful results. The Friedl valve is illustrated in two of our drawings. In the photograph, the valve is sawed open at either end to show the cooling passages. In the center of the photograph is a similar valve showing the holes at both ends of the air passage. At the right is an ordinary inlet valve taken from the same engine.

As will be seen from these illustrations, an air passage is provided very near the end of the stem, to a point close under the head of the valve. Used in connection with this valve is an exhaust port in the form of a Venturi tube. This Venturi causes a stream of air to be drawn through the valve stem and out of the port, with the exhaust valves closed. The expansion of the air under the action of the Venturi produces a refrigerating effect which is most helpful. The Venturi also constitutes an exhaust stack and emits only a faint blue flame (thanks to this refrigerating effect) instead of the usual ring of red flame. Therefore, the exhaust manifold can be dispensed with which means a saving in weight and head resistance.

The air-cooled valve and Venturi exhaust stack system have been tried successfully under many conditions of flight and are most promising.—*A. K.*

Monochromatic Rainbow

SOME of our readers may perhaps have witnessed a red rainbow similar to the one described in a communication received from D. Moreau Barringer, Jr., a geologist. Mr. Barringer was the author of a three-part article entitled "The Most Fascinating Spot on Earth," a description of the famous Meteor Crater in Arizona, which appeared in our July, August, and September numbers in 1927.

"Your readers may be interested in a description of an unusual sight that I was lucky enough to see last summer," Mr. Barringer writes. "The phenomenon was a red rainbow, containing no other colors of the spectrum.

***Above:* At left, an internally cooled exhaust valve cut away to show right, an ordinary valve. *Upper left:* Cross-section of cooled valve installation. *Right:* Venturi stack**

"I was driving east from Tucson, Arizona, on the road toward Bisbee and El Paso, and had reached a point some 20 miles from Tucson when the sun set. The western sky was comparatively clear, but in the east there were great masses of cumulus clouds, some of which were dropping rain. One cloud in particular hung directly above the road ahead, some five miles distant. The sun, shining from below the horizon over my head, lit up this cloud with a deep purplish-red glow. Rain was falling from the cloud, the long streamers of it being also colored red by the sun's light.

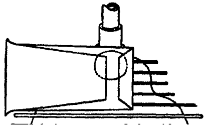
"Encircling the cloud was a narrow, semicircular band of red light, similar, except for its color, to a perfect rainbow. I looked for traces of the other spectral colors, but could see none except the red. The rainbow lasted perhaps two minutes, at the end of which time the sun's light began to fade from the rain-streamers below the cloud, and the bow simultaneously faded out.

"The explanation, of course, is simply that the great thickness of atmosphere traversed by the sun's rays had filtered out of them all the shorter waves of the spectrum, leaving only the red light, which has the greatest penetrating power of the visible spectrum. But it was the great beauty of the spectacle, together with the fact that I had never heard of the phenomenon before, that called my attention to it particularly. Perhaps others among your readers have seen it or heard of it before, but the combination of conditions necessary to produce the spectacle must be rather unusual, and I have thought it worth while to record the observation."

By-product Becomes Chief Product

THE writer retains a very vivid recollection of certain yellow-green lakes of solidified niter-cake which generally adjoined the plants producing nitric acid during the World War. Niter-cake, or sodium acid sulfate, was a by-product of the manufacture of nitric acid by the interaction of Chilean saltpeter with sulfuric acid. Being somewhat of a drug on the market, it was poured, while molten, into depressions in the ground, forming the "lakes." Recently, however, new processes for the manufacture of nitric acid have eliminated this source of the by-product niter-cake, and we now find that the demand for this substance is sufficient to warrant the erection of plants for its manufacture. Thus, at Copper Cliff, Ontario, a plant has recently been built to manufacture niter-cake, a product that was, until recently, hard to dispose of.

The process is relatively simple, chemically. Sodium sulfate is cooked with sulfuric acid in retorts, the resulting niter-cake being poured molten into pans in which it solidifies. The sodium sulfate is obtained from Horse Shoe Lake, Saskatchewan. After harvesting from the lake, the natural sulfate is dried and is shipped practically anhydrous and analyzing 90 percent sodium sulfate. The new plant makes its own sulfuric acid, mixing the dry sodium sulfate with 93 percent acid to form a thick paste. This mixture is fed to oil-fired retorts where the niter-cake is formed. The molten sodium acid sulfate overflows continuously through an opening in the side of the retort, and is caught in a series of pans attached to a moving chain. This conveyor system passes away from the retort at a rate of 120 feet per hour so that the niter-cake has a chance to set and cool in the pans of the conveyor. The cooling is promoted by passing water under the pans on the conveyor. An interesting point is the spraying of the pans with oil so that the cakes will drop out readily when cool. An automatic hammer strikes each pan as it is turning on the cool end of the conveyor, releasing the cake.



All the niter-cake produced in this plant is sold to the International Nickel Company for smelting its copper-nickel matter, whereby the two metals are separated. —*A. E. B.*

Electrical Equipment for the "Nautilus," Arctic Submarine

THE *Nautilus*, a submarine which is being prepared to travel across the top of the earth and beneath the ice at the North Pole, will be elaborately equipped with electric devices, it has been announced by Sir Hubert Wilkins, explorer. Together with other special apparatus of unique design and purpose, these electric appliances will make the submarine a more perfect dwelling place for the crew of 20 than even Jules Verne's famous *Nautilus*, the name of which this modern craft will bear in memory of the great scientific fictionist.

Sir Hubert Wilkins in the *Nautilus*. Note electric refrigerator in rear

Paradoxically perhaps, but none the less truly, Sir Hubert's *Nautilus* will carry a General Electric refrigerator into the Arctic Ocean. The interior of the submarine will be warm enough, even in the frigid zone, to cause food to spoil; the electric refrigerator will be used for the preservation of the food rations of the crew.

The *Nautilus*, recently completed at Philadelphia for its trial runs this spring, will also have a complement of General Electric sunlamps, since the boat will be under water so much of the time that, even though the sun shines 24 hours a day in the land of the midnight sun, the men will be exposed to natural sunlight but little. The crew will need the ultra-violet rays of the artificial sun to keep them in good physical condition.

There will be electric fans to stir up the air when the submarine has been submerged for a long time, giving the air a fresh and invigorating feeling as it is breathed.

One of the General Electric Company's new-type radio receivers will provide the crew with entertainment from broadcasting stations during off-hours of the expedition.

The matter of cleanliness will be taken into account far more than is usual on one of these expeditions through the use of an electric washing machine and an electric vacuum cleaner. An electric stove will be

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Above: **New loudspeaker, showing compactness of unit.** ***Right:*** **Unit and cone with the voice coils attached; core is removed from field**

used for cooking, and there will possibly be a number of electric radiant heaters.

Electric current for these various items of equipment will be supplied by a large storage battery which will also be used for starting the Diesel propulsion engines. There will be an auxiliary Diesel operated electric generator for recharging the storage batteries when necessary.

The *Nautilus* will be able to remain six days under water, if required, without a recharge of the battery or a change of air. It will travel under the ice by the unique method of the "sledding" principle applied upside down. A sled deck and a guide will slide along in light contact with the under-surface of the ice, so that the vessel will behave like a marine fly crawling swiftly along a ceiling of ice.

By means of an ice-cutting tool on top of a special collapsible conning tower, a hole can be bored through several feet of ice, allowing the crew to crawl out through the conning tower to the top of the arctic ice.

A New Loudspeaker

LOUDSPEAKING reproducers in general have not kept up with the advances made in the amplifying equipment that is associated with them. For years the well-known principles of magnetic and dynamic speakers have remained unchanged, refinements in design and construction being the only forward steps that have been made. Now, however, comes a cone-type speaker of radically new design which holds promise of creating a new criterion in reproducer operation. It was invented by H. J. Fanger, formerly experimental engineer for the Brown-Boveri Company.

There is no wide range of movement of the center of this new cone, as is found in conventional speakers. Rather, the voice coils—there are two of them—are fastened rigidly to the center of the cone and are restricted electrically and mechanically to an amplitude of movement of .001 inch, even when reproducing low notes. The higher tones are reproduced by the center of the cone, and the lower by the outer edge where there is considerable amplitude of motion. This is exactly opposite to common practice.

There are two gaps in the magnetic circuit of the field coil, and one voice coil is suspended in each. The two voice coils are wound on the same support which is fastened to the cone.

This new speaker is said to have great clarity of reproduction throughout its entire range, and since it does not depend upon cone resonance for the reproduction of low notes, there is none of the "barrel-like" distortion that is so noticeable in the average speaker.

Because of the type of construction used, it is possible to build this new speaker in very large sizes to handle tremendous power. It is reported that one of them has successfully handled an input of 150 watts. Contrary to the effect produced by the usual speaker, this one does not produce unusual distortion when overloaded. It is said that as the input is increased, the volume builds up until the limit of the speaker is reached; greater input has no effect whatever on volume or quality of reproduction.

At present this speaker is available only in large sizes which, because of the power required to operate them, are not suitable for use in the home.

New Emulsifying Agent Used in Polishes

ANYONE who has ever made mayonnaise knows a little something about emulsions—how careful you have to be to add the oil slowly and what a lot of "elbow grease" you must use to mix the ingredients to form a nice smooth emulsion. These same difficulties, and more, have tried the patience of makers of many industrial products which are also emulsions. But recently they have learned to use substances known as emulsifying agents which greatly simplify the procedure and guarantee the uniformity of the product.

A new emulsifying agent, which comes in the form of a paste and is known as ammonium linoleate, is described by H. Bennett in a recent issue of *Industrial and Engineering Chemistry*. This product is finding many novel applications. To prepare the emulsion, the required amount of ammonium linoleate paste is completely dissolved in water and the oil to be emulsified is added slowly with vigorous stirring until emulsification is complete.

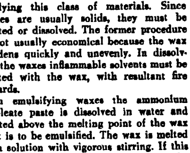
Emulsions made according to the predetermined formulas are useful as sprays, disinfectants, insecticides, lubricants, cleaners, et cetera. When volatile hydrocarbons are emulsified, their flash points are raised sufficiently to make them non-inflammable; thus fire hazards are reduced. Moreover, their vapor tensions are so reduced that they do not evaporate so readily and the resultant loss by volatilization is reduced to a minimum. The formula for making mineral-oil emulsions is typical of the usual oil polish for furniture or automobiles. If desired, a varying amount of tripoli or air-floated silica may be added to produce a silver or other metal polish. In the case of metal polishes the use of ammonia and the evil-smelling oleic acid is eliminated by using the paste.

Good stable wax emulsions have been the despair of many chemists. Many have tried and but few have succeeded. The quest is continued because wax is used in many industries and would be used in many more were it not for the difficulties involved in applying this class of materials. Since waxes are usually solids, they must be melted or dissolved. The former procedure is not usually economical because the wax hardens quickly and unevenly. In dissolving the waxes inflammable solvents must be heated with the wax, with resultant fire hazards.

In emulsifying waxes the ammonium linoleate paste is dissolved in water and heated above the melting point of the wax that is to be emulsified. The wax is melted in a solution with vigorous stirring. If this method is followed exactly, using the proper proportions, excellent stable wax emulsions will be formed. Such emulsions make excellent polishing, waterproofing, lubricating, and filling compounds.—*A. E. B.*

Sensitivity to Cold

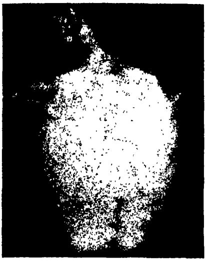
SOME people are much more sensitive to cold than others; indeed, some people respond to changes brought about in the body by cold with eruptions in the form of wheals and blisters that are similar to those produced by sensitivity to various products or drugs. Dr. L. Minor Blackford has described a case of a boy 17 years old who had stood in the water in a swimming pool for 20 minutes and who was observed when coming out of the pool with the typical reaction of sensitivity to chemical products on the skin. The boy had blisters which itched greatly and burned. This discomfort passed away a half hour after he was removed from the cold.



Wheals on legs ten minutes after a 20-minute bath at 20° Cent.

In order to determine whether he was sensitive to cold or not a glass of ice water was held against one thigh for five minutes and a glass containing water of ordinary temperature was held against the other thigh. The thigh on which the ice water was applied developed large blisters in a few minutes. Similar reaction followed the application of ice.

The skin of a person who is sensitive in this way is sensitive to all sorts of irritations; one of the manifestations of a sensitive skin is the condition called dermographia, in which rubbing of the skin by a pencil or finger-nail leaves marks which persist for a considerable time. Dermographia, resulting from stroking with a finger-nail is shown vividly in an accompanying illustration.—*M. F.*



Dermographia resulting from stroking the skin with the finger-nail

Auto Leads as Necessity?

THE automobile apparently is a greater necessity in American life than the telephone or radio, American Research Foundation stated. There are 23,122,000 automobiles, it said, against 20,206,000 telephones and 13,000,000 radio receiving sets.—*Barron's.*

Triple-fast Movie Film

FROM the astronomical observatory to the movie lot a new triple-fast photographic emulsion has come to make motion picture production cheaper and more flexible.

The motion picture film introduced to the profession recently is described by the Eastman Kodak Company as "the greatest advance in motion picture materials since the introduction of panchromatic film 18 years ago." Its sensitive emulsion is very closely related to one prepared for astronomical photography which has been used to reduce the time required for making exposures through large telescopes. An improvement in the photographic plates used is just as effective in this case as though the telescope itself were increased in size. The super-speed panchromatic plates produced for newspaper photographers are also very similar to the new movie emulsion.

When the movies went talkie it was necessary to banish the familiar arc lamps on account of their noise. Large incandescent

(*Please turn to page* 350)

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THE AMATEUR ASTRONOMER

Conducted by **ALBERT G. INGALLS**

NOW and then someone with the best of intentions proposes that the telescopes made by amateur workers be "standardized" by means of uniform instructions for making—blueprints and all that kind of thing. As soon as we have recovered from the shock occasioned by this heresy we say to such reformers that, on the contrary, the most interesting and promising aspect of the amateur telescope making hobby has been the extreme *variety* of the designs produced. Like human faces, no two are alike. Starting with the fundamental principles of design stated in the book "Amateur Telescope Making" every worker concocts his own telescope and this is half the fun. The telescopes shown this month are originals.

HERE is a letter from A. Wade, mechanical engineer, connected with the Industrial Accident Commission of the Department of Industrial Relations of the State of California, 906 Associated Realty Building, Sixth and Olive Streets, Los Angeles. "In June, 1926, you published the picture of my first telescope. The present photograph shows my latest. Nothing is being said about the score or more of intermediate ones, though only four pieces of glass and three different mountings were involved in the struggle.

"The picture tells most of the story, though it may not be obvious that the tube can be rotated in the mounting. The mirror is 11¼ inches in diameter, with a focal length of 100 inches. The little electric motor that drives the polar axis is in the bottom of the pier.

"Some time ago you invited amateurs to tell what their telescopes would do in the way of definition, but I have seen but little on this point. (Reason: nothing came. —*Ed.*) Perfection is not claimed for this creation, but the components of double stars separated by one second of arc can been seen; for example, *Eta Orionis*. I can also see the chain of lunar craterlets near Copernicus, and the less conspicuous indentations in the submerged crater Stadius.

"In the picture of the telescope the bright line near the worm gear is part of the *sidereal* circle mounted on the gear. The hour circle is on the polar axis."

Mr. Wade cut the slots in the tube to ventilate it better, with the purpose of gaining improved seeing. He says he has not yet discovered any improvement.

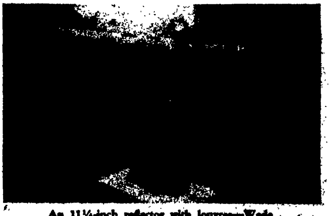
The optical pipe organ—Stoot

THE first telescope tube in the universe made of an organ pipe was used by Stephen Stoot, connected with Casavant Frères, pipe organ builders, St. Hyacinthe, P. Q., Canada, on his telescope. He writes: "In addition to the vast amount of information on mirror making contained in the SCIENTIFIC AMERICAN book 'Amateur Telescope Making' I received some valuable hints from Mr. H. L. Rogers of Toronto. He has made four telescopes, three being of six-inch diameter and one of 12-inch. The telescope works well and results were beyond my expectations.

"The tube is a portion of a 6¼-inch organ pipe of hard-rolled zinc, 16-gage, and may be rotated in its cradle of maple. The polar axis was made from a discarded check-valve case from the old steam heating system in our factory. It had an inclination of 45°, and as the latitude of St. Hyacinthe is 45° 37′ 15″ I decided to use it. The rest of the mounting is made of pipe fittings. The slow motions are from an old-time gramaphone drive. For the base a block of concrete two feet square at the bottom, one foot square at the top and four feet high was set in an excavation four feet deep. Embedded in its center is a three-inch iron shaft surmounted by a flange seven inches in diameter. Upon this platform the rest of the mounting is constructed and in such a manner that it can be removed and taken indoors. When the upper part of the mounting and telescope are removed the cell is left on top of the pillar. The parts may seem heavy for a six-inch telescope but I have found it difficult to err on the side of rigidity if one wants comfort in observing anything in the heavens."

Mr. Stoot's insistence on rigidity surely requires no apology and his mounting contrasts favorably to some of the "India rubber" mountings we have seen. As for keeping the mirror out of doors, that is where we keep ours—right on top of the tube of our 10-inch Springfield mounting, covered by a tin cap, and always self-adjusted to the temperature.

THE simple wooden "spinal column" mounting for a small mirror, described by Russell W. Porter in "Amateur Telescope Making" (page 28-30), has been expanded to take a 12-inch mirror of 99 inches focal length by George F. Walker, 920 Twelfth Street, Bremerton, Oregon. Mr. Walker writes: "The cement, sand, and gravel cost about two dollars. I cut the steel reinforcing rods from old bed ends. A bronze bushing 14 inches long, cast in the concrete, provides a bearing for the polar axis; it came from a junk pile and happened to be a snug fit for the 1½-inch cold-rolled steel axis. The yoke is a piece of three-inch steel channel. Two split bearings cast from babbit metal carry the 1¼-inch declination axis and the latter has a flange which bolts to the wooden "backbone" of the telescope. Notice the concrete counterweight cast into a pipe which adorns the other end.



An 11¼-inch reflector with louvres—Wade

Glorified Porter spinal-column mounting—Walker

"The declination and polar axes are driven by two 360-tooth worm gears, and for moving the declination axis the worm lifts out of mesh. Just now I am casting about for a cheap, husky clock to keep the zero mark pointing at the celestial meridian.

"The backbone of the telescope is a good clear two-by-six cut from Washington's famous Douglas fir. The mounting is rugged and relatively steady but I notice that when anyone is walking nearby, the earth itself is only relatively steady."

A *philatelist's alt-azimuth*—*Davis*

WE never had flattered ourselves that telescope making was as serious a disease as stamp collecting (our wife collects stamps and we therefore speak advisedly) but the impossible has now come to pass. A stamp enthusiast, the secretary of the American Philatelic Society, Dr. H. A. Davis, 3421 Colfax A, Denver, Colorado, has made a telescope, and sends in a picture of it. The accompanying confession reads: "I was one of the first to purchase 'Amateur Telescope Making,' in 1926 and have finished a telescope after all this time. Never have I put more than 30 minutes' work on the job at a given time. In fact, it was done principally in five and ten-minute periods, demonstrating that a man with absolutely no spare time (seemingly) can accomplish much by making use of short snatches of opportunity.

"The mounting is an alt-azimuth and has one worm gear working directly in the quadrant cut from an auto ring gear. For the slow motion in azimuth I used a stock brass plate gear of 16-pitch, with worm to match. The mounting is made of sugar pine."

Mr. Davis's telescope is trim and workmanlike. We hope the publication of the above evidence of his partial apostasy from stamp collecting will not result in his subjection to trial by the philatelists for worshipping false gods. Besides, there may also be telescope addicts who have indulged, on the sly, in stamp collecting. But when it comes to being addicted to both diseases it seems almost like leading a double life.

We have three lines left—just enough to beat the tom-tom about a big book every amateur has cried for. See page 355, quick!

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(Continued from page 347)

lamps are used. These are rich in red light which does not register effectively on ordinary movie negative. The new supersensitive film is affected by both red and green light to a much greater extent than previous film.

Camera men will now be able to "stop down" their lenses and get an increased depth of focus which will allow the actors to move around with less fear of getting out of focus. Or they will be able to use less light and save money.—*Science Service.*

Russia Plans 16 Rayon Plants

THE Soviet Government proposes to construct 16 rayon plants, costing 125,000,000 dollars, with an annual productive output of 35,000 tons, according to Soviet reports received by the United States Department of Commerce. Three rayon mills are under construction and are expected to commence operation this summer.

The productive capacity of the three mills under construction is estimated at between 8000 and 9000 pounds per day, according to Soviet information.

Two Soviet trusts have signed five-year contracts with a German firm for constructing and starting in operation two rayon factories, the German firm to prepare plans for construction, to give expert opinion, and to turn over to the Soviet trusts licenses for all its patents and processes. The German firm is also to train Soviet engineers and workmen in its German plants, as well as send German specialists to Russia. The equipment will be ordered partly in Russia and partly from abroad. Only domestic raw materials will be used for rayon production in these factories.—*A. E. B.*

Effects of Training on Efficiency

IN 1930, investigators in the department of physiology of Johns Hopkins University showed that the daily repetition of the same amount of light muscular work on a bicycle brought about a gradual increase in the total ventilation of the lungs and a decrease in the pulse rate as the training progressed. The total amount of chemical interchange in the body during such work also showed a slight decrease. The investigators have now made available a study of the effect of training on track athletes in the university.

Seven men with athletic training and seven non-athletes were selected at the beginning of the season, and the amount of chemical interchange in their bodies, as represented by the metabolism developed in running 70 yards, was calculated. The investigations included also studies of the ventilation of the lungs, the rate of the respiration and the pulse, and the blood pressure during the period of recovery following exercise. It was found that the metabolism, the blood pressure, the pulse rate, and the ventilation for the recovery period did not change during the training. Two of the men carefully studied noticed that they were able to run faster and for longer distances and that the running became easier as the training proceeded. Apparently the main factor contributing to this increased ability is the factor of increased total ventilation of the lungs.—*M. F.*

Electric Refrigerator Most Popular Appliance

THREE million American families now protect their food supply by electric refrigeration, a co-operative survey by 20 leading refrigerator manufacturers reveals.

Sales in 1930 totalled 770,000 refrigerators, valued at 223,320,000 dollars, a sum equal to about 31 percent of the value of all household electric supplies sold in the year. Including refrigerators sold for commercial use, the year's sales were 1,002,000 refrigeration units, having a value of 380,120,000 dollars.

Notwithstanding the volume of business done with the cooling units, only 14.7 percent of American homes are equipped with electric refrigerators, the survey shows.

Chile's Saltpeter Tax Income

WHILE American chemists concern themselves with new methods of making nitrates, as, for example, by the catalytic oxidation of ammonia, the producers of natural sodium nitrate in Chile are planning to defend their world markets against the threat of synthetic competition.

The Government of Chile has long depended upon the export tax on nitrate as a major source of income. With the formation of the Cosach, the export tax was lifted, the government instead sharing as an equal partner in the future operation of the industry with a guaranteed return in 1931, 1932, and 1933. The managing interests in the company now favor utilizing its earnings in the modernization of the company, thus tending to cut off financial returns to the government. At the current conferences, alternative methods of financing the government to carry out this program will be considered. The agreement under which the company was formed provided for minimum payments to the government on its stock interest for the sacrifice of the export tax. That tax amounted to $12.32 per metric ton.

It is understood that a tentative proposal may be suggested to the Chilean delegates, calling for the return of the earnings of the nitrate companies to their businesses for the next year, instead of the payment of 22,500,000 dollars of it to the government as part compensation for the remission of the export tax on nitrates and iodine. For the government's immediate compensation, and to provide it with funds for expenses while the tax is inoperative and nothing is received from the companies, it is understood that there will be a proposal for a direct Chilean Government bond issue. Amortization of these bonds would take place with funds paid in by the nitrate companies as they achieve larger earning capacity.—*A. E. B.*

Coating Applied to Pipes Automatically

A MACHINE to coat pipe lines automatically with cement is being marketed by the Conley Plastering Machine

Company of Compton, California. It is asserted by the manufacturer that cement coatings applied by this method prevent corrosion, as shown by many tests. The machine instantaneously mixes and applies the plastic coating, using only enough water to hydrate the cement properly, giving a dense, mechanically water-proofed mass and a centrifugally welded bond between the pipe surface and coating.

The machine weighs approximately 1500 pounds, is easily handled in soft or marshy ground or over mountainous places, incorporates its own power plant and will cover from 2000 to 3000 feet of 4-inch pipe in eight hours with a cement coating one half inch thick. It can be used also to apply asbestos coatings for fractionating towers, boilers, and steam pipe insulation. —*A. E. B.*

Headaches of Nasal Origin

THERE are innumerable causes of headaches, but among the most frequent are infections of the sinuses surrounding the nose. In such cases the headaches may be [illegible] it of the head o [illegible] anterior cases, the pain is usually over the eyes and is associated with moving the eyes. The pain usually comes on at a definite hour, rapidly becomes more severe, and after a few hours lessens, but returns [illegible]

and the teeth will be found [illegible] ssure. The interior of the nose is usually swollen and tender.

When the nasal congestion is diminished, a free flow of secretion takes plac [illegible] headaches disappear. In the chronic cases there is usually some anatomical obstruction to the passing of mucus from the frontal or maxillary sinuses. People find that these headaches become worse by close application of the vision, such as occurs in reading or sewing. When the X ray is applied to these cases, the sinuses will be found cloudy because of the presence of retained secretion.

Headaches in the back of the head are usually associated with inflammations in the ethmoid and the sphenoidal sinuses. Dr. Georges Canuyt finds that these headaches are more frequent in young women who may show extreme nervousness and who complain of pain in the center of the head, back of the head, or behind the eyes. Inflammation or infection of these sinuses is extremely difficult to diagnose and involves the most careful study by competent specialists in diseases of the nose and throat. In such cases treatment by cocainization of the sphenopalatine ganglion and various surgical procedures applied to the turbinates and the ethmoids may relieve the headaches permanently.—*M. F.*

Measuring the Temperature of Flames

THE temperature of solids may be estimated by the eye or accurately measured by means of a thermometer, thermocouple, or optical pyrometer. Flames, particularly non-luminous ones, present a more difficult problem. A flame may be hot enough to melt platinum and yet look fairly cool to the eye; conversely, there are certain luminous cool flames which will not burn the hand. This is because the radiation from flames does not follow the laws which apply to solids; for example, much of the radiation from the ordinary Bunsen type of flame is in the invisible infra-red region of the spectrum.

In a method for measuring flame temperature being employed at the Pittsburgh Experiment Station of the United States Bureau of Mines, the flame is colored yellow with sodium vapor and the intensity of this light compared in a spectroscope with the light from a heated solid at known temperature. Values have been obtained for stationary flames of different mixtures of air with methane, ethane, propane, butane, isobutane, ethylene, propylene, and butylene. Maximum flame temperatures vary from 1880 degrees Centigrade for methane, to 1975 degrees for ethylene.—*A. E. B.*

CLEMENCEAU AND FOCH

By Captain W. D. Puleston

(*Continued from page 331*)

Clemenceau did not hesitate to take a bold stand against Germany: but not until he had consulted the Minister of War, Gen Picquart, and been advised that French Army was ready for war after he had received assurances the British Government that if Ger were the aggressor, public opinion in [illegible]

[illegible] The fiery Premier was careful to consult his possible allies and the head of his own army before involving his country in the hazards of war.

It was during this period and a sistence of General Picquart, W [illegible] that free-thinking, anti-clerical Clemenceau appointed Foch to be Commandant of the Ecole de Guerre, although his brother was a Jesuit priest, and Foch, himself, a devout, almost mystic Catholic. Foch was surprised at his selection by Clemenceau. This was the first official contact of the two men, and their paths quickly separated until 1914; for Foch, absorbed in his profession, had little time for politicians, [illegible] busy with his own affairs, paid little heed to Foch.

Clemenceau resigned office in 1909 convinced that Germany was an implacable enemy awaiting only a favorable moment to attack France. He was still the formidable foe of French cabinets but he took a more national view after his premiership. The responsibilities he faced as head of the Government prepared him for his more difficult war premiership.

In 1913 he founded his last journal, *L'Homme Libre*, which treated all current and domestic subjects, but continuously reminded France of the German menace. He gave his powerful support to all efforts to increase the efficiency of the French Army and to strengthen the ties of the Triple Entente.

When the World War began, a political truce was declared in France and on August 26 Prime Minister Viviani admitted additional members to broaden the base of his cabinet. This coalition cabinet resigned when the Allied efforts in the Balkans failed in October, 1915. Briand formed the new government and admitted members of other political groups, making a still more representative but an exceedingly unwieldy cabinet. This cabinet conducted the war until December, 1916, when it was reduced

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by half and the direction of the war entrusted to a War Committee of Five.

When the war came, Clemenceau did not hesitate to criticize the short-comings of the coalition governments in his paper, and when the censor interfered, he changed the title of his paper to *L'Homme Enchainé*, but continued his criticism. His criticisms were really exhortations to the Government to take more vigorous action against both foreign and domestic enemies, and while the censor continued to blot out many columns of his paper, he never stopped his attacks, and gradually came to personify those Frenchmen who were determined to endure all and risk all rather than to submit again to Germany.

Briand resigned in March, 1917, and was followed by two other coalition governments headed by Ribot and Painleve, that together lasted only about eight months. Then, finally, but only in response to a growing public opinion that Clemenceau was the one leader who could save France, Poincare, much against his will, summoned Clemenceau to form the Government. Clemenceau abandoned the coalition scheme of government, and in November, 1917, formed a more homogeneous cabinet and one closely allied to the radical-socialist party. He purged the cabinet of monarchists, conservative republicans, socialist-republicans, and unified socialists. He drove Malvy, who had served as Minister of the Interior in every war cabinet, from office; he banished the powerful Caillaux and executed the notorious Bolo Pasha. He did not hesitate to accept the Government when a large portion of the French Army was mutinous and when the French legislature was honeycombed with defeatists. Nor did he complain when he took over the Army that he was given a desperate situation to cure; he took his position proudly, as if he were convinced, like the great Pitt, that he could save his country, and no one else could.

FOCH remained at the Ecole de Guerre until 1911, leaving to command a division of troops. In 1912 he was given command of the XXth Army Corps, in the Nancy area, specially formed and trained to cover the mobilization of France from a sudden German attack. The outbreak of war found Foch still in command of the XXth Army Corps, and a part of Castelnau's Second Army. On August 27th he was recalled by Joffre to form the Ninth Army, in command of which he distinguished himself at the first battle of the Marne.

After the battle of the Marne he was sent by Joffre to control and coordinate the efforts of the French, British, and Belgians in the fighting around Ypres in October, November, and December, 1914. His long friendship with Sir Henry Wilson, Deputy Chief of Staff of the British Army, greatly facilitated the co-operation of the British and French in 1914, and indeed throughout 1915, when as Joffre's deputy on the northwest front in command of the Group of Armies of the North, he took part with the British in the Second Battle of Ypres and the Battle of Artois. In 1916 Foch was again in close touch with the British in the Battle of the Somme, which was intended primarily to relieve the German pressure of Verdun and secondly to drive the Germans out of France. During 1914 and part of 1915 he was in desultory communication with Clemenceau through Clemenceau's brother, who was an enlisted man.

The results at Verdun and the failure of the Somme offensive caused the replacement of Joffre on December 12, 1916, by General Nivelle. The failure of the Somme had previously caused the retirement of Foch from an active command to head of a board to investigate Inter-Allied questions.

Nivelle launched his famous offensive in April, 1917; it failed and he was relieved as Commander-in-Chief of the Army by Petain, the Chief of Staff, who was succeeded by Foch on May 15, 1917. In this position Foch was the official military adviser of the French Government. So when Clemenceau became Premier in November, 1917, he found Foch already established as Chief of Staff of the French Army, after having narrowly escaped complete retirement. For the second time Foch came into close official contact with Clemenceau, who nobly supported him and Petain in recreating the morale of the French Army, badly shaken by the failure of Nivelle's offensive. During this period although Clemenceau and Foch had some differences they were able to settle them amicably over the tea table. At this time Foch apparently supported Clemenceau's view that American battalions should be brigaded with British and French Armies.

ON March 21 Hindenburg launched the expected German attack against the Third and Fifth British Armies; it was temporarily successful and it seemed certain to drive a wedge between the French and English armies near Amiens. The situation rapidly became critical; on March 23 by the advice of General Petain, Clemenceau had told President Poincare that the Government should prepare to abandon Paris. On March 24 Foch submitted to Clemenceau his considered opinion of the situation, ending with the ominous statement that "Nothing is ready for the maintenance of an indispensable collaboration between the French and British Armies." Clemenceau, under the enormous strain, hastily and unjustly concluding that Foch was preparing his own exoneration, exclaimed, "So you are abandoning me!" Foch quickly reassured him, and as they both were convinced that the British and French Armies must maintain contact at all costs, an agreement on the allied objective was easily reached, and during the last dangerous days of March, they worked in complete harmony.

This occasion reveals the responsibilities resting upon Clemenceau; he had promised the Deputies victory and they had given him a free hand, but after three days of battle Petain, the French Commander-in-Chief, despaired of maintaining contact with the British Army and defending Paris. Nivelle was in military disrepute. Joffre no longer enjoyed the confidence of his countrymen, and Foch, the last military hope of France, was apparently seeking to justify himself when the seemingly inevitable crash was about to be fully revealed to the French people.

It was a recognized procedure among French political leaders to disassociate themselves quickly from a cabinet about to be overthrown, and Clemenceau for a moment believed Foch was preparing to abandon him to similar precipitation. But Foch had no such intention and while he once indulged in a snarling growl about the desperate situation he was called upon to remedy, he never intended to separate himself or his professional reputation from the fortunes of France. He had memories of 1870, as poignant as Clemenceau's.

At Doullens, on March 25, 1918, Foch was made Generalissimo of the Allied Forces. He was summoned to take command of the British and French Armies when the British Fifth Army was in full retreat and the remainder of the British Army and the French Army were both apprehensive of the next German attack. His first task was to prevent the rupture of the British-French line at Amiens.

IT was around Amiens during this trying period of March and April, 1918, that Clemenceau and Foch drew closest together. Clemenceau has testified how Foch inspired the British and French leaders, civil and military, with his stirring declaration: "I would fight them in front of Amiens; I would fight them in Amiens; I would fight them behind Amiens." No less intrepid was Clemenceau, and Lord Milner testifies that on March 25 he was "in great form, and very full of fight, and while acutely realizing the gravity of the situation, showed not the slightest sign either of despondency or confusion."

Haig had already turned over the remnants of Gough's Fifth Army to Petain, who had put in six French Divisions at Noyon and was bringing up nine more French Divisions. Both Petain and Haig felt they could spare no more divisions without incurring grave danger of disaster in other parts of the line that lay open to German attack.

Foch immediately on taking supreme command proceeded to Gough's headquarters at Dury and inspired him to make still further demands on his hard-pressed army, for Gough's army must hold until Debeney's army could be constituted. During the next few days Foch was repeatedly questioned by high British and French officials whether he would defend Paris or the Channel ports in case the allied line was pierced. He invariably answered that he "would defend them both." No amount of questioning budged him from this attitude; even his old friend "Henri" Wilson failed to obtain any other answer. And in the end he did what he had promised.

Having blocked the German advance at Amiens, Foch's next task was to dispose the allied reserves so that any German thrust at the Channel ports or at Paris could be parried and still leave him with enough fresh divisions to make a counter attack when the German attacks were fully countered. For though temporarily restricted to the defensive, Foch looked forward to assuming the offensive as early as possible.

The Germans' next blow fell on the British Army in the north of France. On April 9 heavy fighting forced the British to give ground and on the 12th, Haig issued his famous "Backs to the wall!" appeal to the men who stood between Hindenburg and the Channel ports. Foch steeled his heart to refuse Haig's request for rein[illegible]. So close was the decision in the north that Foch temporarily incurred English displeasure, but as Foch had estimated, there was just enough strength left in the British line to deny the German advance.

On May 27 Hindenburg turned from the British to the French front, and attacked along the Chemin des Dames, and after four days of fighting the Germans reached the Marne at Jaulgonne. This time the French Army demanded Foch's reserve divisions, but he gave them very grudgingly and only after it was clearly apparent that the German thrust towards Paris was their major effort. By June 4 the German advance towards Paris was definitely checked. And Foch by his extreme frugality in using the allied reserves, had enough fresh divisions to launch a counter attack and his eye had already noted the point of the great bulge in the German line near Soissons where a successful attack would force a hurried German withdrawal. Since receiving the Allied Command in March, Foch had been forced to conform to Hindenburg's moves; in July the German reserves were consumed and Foch on account of his former penuriousness, had some fresh divisions in hand. The initiative passed to Foch and the world knows how successfully he employed it beginning at Soissons in June and continuing until the Armistice.

The whole world applauds Foch now, but on May 30 there was agitation among the Deputies demanding his removal on account of the German successes along the Chemin des Dames and then Clemenceau rose to his full stature and on June 4 offered his resignation if need be, but firmly supported Foch, who was even then planning his counter stroke against the Germans. There both Clemenceau and Foch were truly magnificent: Foch, on the eve of reaping for the Allies the reward of his patient and successful resistance to German attack, about to be struck down by Deputies, for the most part patriotic but who knew not what they proposed to do; and Clemenceau, not entirely approving Foch's actions, not thoroughly understanding his motives, but trusting his ability and patriotism, threw about Foch his own authority, and stood between Foch and retirement, and between France and disaster. Fortunate was France that, in this supreme trial, her civil and her military establishments could produce a Clemenceau and a Foch.

●

If any of our readers are interested in the full biographies upon which the above article is based, we refer to the following:

"Foch" by Maj. Gen'l. Sir George C. Aston, K. C. B. The English viewpoint.

"Life of Marshall Foch" by Capt. B. H. Liddell Hart.

"My Conversations with Foch" by Raymond Recouly.

"Grandeur and Misery of Victory" by Georges Clemenceau.

"In the Evening of My Thought" by Georges Clemenceau.

"Georges Clemenceau" by Jean Martet, his secretary and personal friend.

"The Tiger: Georges Clemenceau" by George J. Adam.

The next article by Captain Puleston will deal with disputes that the methods to be used in employing the American forces in France, and with the Armistice.—The Editor.

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American Standard Specifications for Dry Cells and Batteries (Circular No. 390, Bureau of Standards, Department of Commerce) gives brief and approved specifications. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

Le Génie Civil (Semi-Centennial Number 1880-1930) is a huge quarto publication of 236 pages and reviews (in French) progress along all the lines of engineering for the last half century. It is profusely illustrated. *Le Génie Civil, 5 Rue Jules-Lefebre, (IX) Paris, France.—25 francs. International money order.*

Westinghouse Instruments, Relays and Electronic Devices (Catalogue 211) is a valuable manual of 186 pages, profusely illustrated with half-tones and diagrams. *Westinghouse Electric and Manufacturing Company, Newark Works, Newark, N. J.—Gratis.*

Fertilizers for Pecan Soils (Leaflet No. 71, U. S. Department of Agriculture) by J. J. Skinner gives valuable information about an important crop. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

Heat Transfer in Ammonia Condensers Part III (Bulletin No. 209, Engineering Experiment Station, University of Illinois) by Alonzo P. Kratz, Horace J. MacIntire and Richard E. Gould is an important study in refrigeration. *Engineering Experiment Station, University of Illinois, Urbana, Ill. —35 cents.*

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Gliders and Gliding (Aeronautics Bulletin No. 22, Aeronautic Branch U. S. Department of Commerce) gives information that everyone needs who wishes to try gliding for sport, recreational purposes, or for the furtherance of aviation. *Aeronautics Branch, Department of Commerce, Washington, D. C.—Gratis.*

Aircraft Engine Testing (Aeronautics Bulletin No. 12, U. S. Department of Commerce) gives invaluable information as to equipment and tests. *Aeronautics Branch, Department of Commerce, Washington, D. C.—Gratis.*

Civil Engineering, a comparatively new publication, fills a long felt want for a periodical on civil engineering which the tired C. E. can read and enjoy in his spare time. The price is five dollars a year and four dollars to members of the A. S. C. E. and to libraries. It is profusely illustrated and is well printed. It is not published by the American Society of Mechanical Engineers as erroneously stated in a former notice, but by the *American Society of Civil Engineers, 33 West 39th St., New York City.—Single copies 50 cents.*

The Federal Airways System (Aeronautics Bulletin No. 24, Aeronautics Branch U. S. Department of Commerce) gives an account of the establishment by the Aeronautics Branch, of 15,000 miles of airways lighted and equipped with intermediate landing fields, and plans for extending the system. *Aeronautics Branch, U. S. Department of Commerce.—Gratis.*

Sorbitic Meehanite—A New Metal to Replace Cast Iron. This is a circular concerning a sorbitic iron with remarkable properties. It has the advantages of gray iron but is tough like steel, resists abrasion, and may be treated or chilled. *Dodge Manufacturing Co., Toronto, Canada.—Gratis.*

Nickel Steel Data and Applications (From Report of the Iron and Steel Division, Society of Automotive Engineers) gives in leaflet form standard specifications for steels. *International Nickel Company, Inc., 67 Wall St., New York.—Gratis.*

The Progress of American Chemistry Since the Outbreak of the World War (Reprint from January, 1931 issue of *Industrial and Engineering Chemistry*) by William A. Hamor and Lawrence W. Bass gives the events in the chemical world from 1914-1930. *Address Mellon Institute of Industrial Research, Pittsburgh, Pa.—Gratis.*

Preservation of Leather Bookbindings (Leaflet No. 69, United States Department of Agriculture) by R. W. Frey and F. P. Veitch, gives exceedingly valuable formulas for dressing for bindings. The few illustrations are excellent. *Office of Information, United States Department of Agriculture, Washington, D. C.—Gratis.*

Development of Oxwelding and Cutting (Jan. 1931 issue of "Oxy-Acetylene Tips") describes the commercial development of the oxy-acetylene process which has taken place in the last 30 years. *Technical Publicity Department, The Linde Air Products Company, 205 East 42nd Street, New York City.—Gratis.*

A Rapid Method of Predicting the Distribution of Daylight in Buildings (Engineering Research Bulletin Department of Engineering 1 University of Michigan) by Waclaw-Turner-Szymanowski describes a method which has given wonderful results. With the system it is possible to predict the lighting during any season; it also shows the difference between clear and dirty skylight lighting. It is profusely illustrated with diagrams and graphs for use with various types of buildings. *Department of Engineering Research, University of Michigan, Ann Arbor, Mich.—$1.00.*

BOOKS SELECTED BY THE EDITORS

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COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar
Registered Patent Attorney

Foreign Telephone Patent Suit Settled

A COURT of arbitration in London has handed down a decision in favor of the Standard Telephone and Cables, Ltd., British affiliate of the International Telephone and Telegraph Corporation, the defendant in a claim for compensation by the German electrical manufacturing company, Siemens and Halske Aktiengesellschaft, for an alleged breach of a patent agreement made in 1921.

The court disallowed the claims of Siemens and Halske A. G.; awarded costs to the defendant; and gave the defendant the right to claim damages from the plaintiff.

Siemens and Halske filed the claim against Standard Telephone and Cables, Ltd., for denouncing a patent agreement inherited by the International Telephone and Telegraph Corporation upon its acquisition from the Western Electric Company of the International Western Electric Company in 1925. Standard Telephone and Cables, a manufacturing unit of the International Telephone and Telegraph Corporation, contended, in combating the German claim, that Siemens and Halske were responsible for the breach of the old International Western Electric agreement, and the court found accordingly.

The original agreement between Siemens and Halske and the former International Western Electric Company was concluded in 1913. It gave the Siemens group an increased quota of the world's telephone business. It lapsed at the time of the war but was renewed in 1921 on the basis of an exchange of patents between the two companies and the Automatic Electric companies, affiliated with Siemens since 1909.

An involved patent situation and the intricate marketing problems occasioned by the Siemens and Halske relations with Automatic as well as with International finally resulted in the denouncing of the 1921 patent agreement and the bringing by Siemens and Halske of its claim for compensation. A feature of the claim was that it did not ask fulfillment of the 1921 agreement but merely compensation for non-fulfillment.

Siemens and Halske, one of the principal rivals of the International Telephone and Telegraph Corporation, in recent years has been a brisk competitor of the International interests and upon two occasions has joined hands with L. M. Ericsson Telefonaktiebolaget of Sweden to win telephone concessions in Greece and Rumania. The International group won in Rumania but lost in bidding for a Greek concession. The Ericsson organization, Siemens and Halske, and International are called the "big three" in international telephony.

Automatic Electric, Inc., of Chicago is a manufacturing unit of the General Telephone and Electric Corporation, sponsored by [illegible] Transamerica and Gary interests in this country and by affiliated British interests. The company exports all its products and has had patent and licensing arrangements with Siemens and Halske since 1909, embodying the use of the Strowger automatic telephone system.

MR. LIDDY will be pleased to answer the inquiries of our readers who may desire information relative to the various subjects reported in his department.
—The Editor.

The victory of the British manufacturing affiliate of the International Telephone and Telegraph Corporation, by disposing definitely of the former Siemens and Halske patent agreement, is believed by observers to have strengthened the hands of the International in its bid for telephone business abroad.

By the purchase of a share in a group of German telephone manufacturing concerns and through an indirect affiliation with A. E. G., the German General Electric Company, the International group has an important share in the telephone business of Germany, as well as in other countries. This has brought about several public clashes between the managements of Siemens and Halske and the Allgemeine Elektricitaets Gesellschaft in recent years.

Glass Trademark Upheld

IN a recent decision Assistant Commissioner Moore held that Louis J. Kolb of Philadelphia, Pennsylvania, is entitled to register, under the Act of 1905, as a trademark for sheets of glass, a mark described as consisting of a band or coating of metallic silver-like compound arranged about the perimeter of glass sheets including laminated glass sheets in the case of small sheets, and extending slightly inward between the glass sheets and showing through the glass in the case of large laminated glass sheets, the fundamental feature being the silver-like band about the perimeter of the glass but no claim is made to the representation of the goods *per se.*

In his decision, after stating that the mark was rejected as being merely a functional feature of the goods and noting applicant's contention that it is not feasible to print words on the glass, and stating that the ruling of the Supreme Court in A. Leschen and Sons Rope Company *vs.* Broderick and Bascom Rope Company, is deemed sufficient authority to hold the mark registrable, the Assistant Commissioner said:

"In the instant case the 'silver-like' color is impressed in a rectangular figure, the figure constituting the mark being applied to the glass by arranging the mark 'about the perimeter of glass sheets.'"

Then, after stating as a general proposition that whether a mark constitutes a trademark depends largely upon the effect which it produces upon the minds of the public, he said:

"[illegible] applicant's case as long as the band or coating of metallic silver-like compound forms no necessary part of the sheet of glass, but is merely associated therewith in the manner indicated, it is believed that the members of the public would regard it as having no other function than that of a trademark."

Fumigant Patent For Public Use

THE benefits of what has proved to be the most effective known fumigant for certain foodstuffs stored in quantity have just been given to the Government and the people of the United States by two scientists of the United States Department of Agriculture, Dr. Ruric C. Roark, a chemist of the Bureau of Chemistry and Soils, and Dr. Richard T. Cotton, an entomologist of the Bureau of Entomology, who recently obtained a patent on ethylene oxide as a fumigant and insecticide.

The value of ethylene oxide as a fumigant was first proved by Doctors Roark and Cotton in the laboratories of the Department of Agriculture in April, 1927, when they inserted one twentieth of a cubic centimeter of this colorless gas into a half liter flask containing a large number of weevils in 200 cubic centimeters of wheat. All the weevils in the flask were quickly killed by the gas.

In 1928 ethylene oxide was first tried on a commercial scale when Doctor Roark and Doctor Cotton successfully used the gas to destroy the weevils in a carload of grain in Baltimore.

Since that time ethylene oxide mixed with carbon dioxide has been used successfully to fumigate great quantities of foodstuffs such as nuts, dried fruits, and packaged cereals in which it effectively prevents the multiplication of insects and consequent deterioration.

This method of fumigation is proving valuable to the raisin industry and it is believed that its use will be rapidly extended to other products such as tobacco, stored silks, wool, textiles, and upholstered furniture.

Ethylene oxide was the reward of a long search by specialists of the Department of Agriculture for a fumigant that could be used almost anywhere without excessive danger of fire or explosion, and without undue danger to human health. The gas, which is free from the fire and explosion hazard when used according to directions, is deadly to insects, but is comparatively harmless to man and does not appear to leave on the treated materials obnoxious odors or residues harmful to humans or animals.

Ethylene oxide has been used already with success in grocery stores, hospital food-supply rooms, in fumigatable storage bins in dried fruit establishments, work rooms, candy establishments, and for treating tobacco. It has been used with apparent success in large concrete elevator bins containing wheat and in lofts in reinforced concrete warehouses where grain products such as animal feeds are stored. The Navy Department fumigated with excellent results more than 10,000 pounds of sacked rice in a modern quartermaster's depot.

Ginger Ale Need Not be "Six Months Old"

CLIQUOT CLUB COMPANY, of Millis, Mass., is ordered by the Federal Trade Commission to cease advertising that its ginger ale has been or is aged six months or six months in the making, unless or until it actually has been or is of that age prior to its sale.

The Commission found that until April, 1929, Cliquot advertised in periodicals and through radio broadcasting that its ginger ale was unripe and injurious unless it had been aged six months and that the product offered for sale had been aged six months, and had derived a fullness of flavor and mellowness of tone as a result of such aging process.

In April, 1929, the company discontinued its practice of representing that its ginger ale had been aged six months and adopted as a substitute therefor the phrase "aged six months in the making," which it continued to employ in its advertising.

However, the Commission found that such ginger ale has not been and is not aged six months or six months in the making. A flavoring mixture called the concentrate, from which the finished ginger ale product is made, has been and actually is aged six months in storage tanks. After the concentrate has been so aged it is mixed with other ingredients of the product, but is in weight about one fifth of one percent of the product.

The Commission found that the finished beverage is neither aged six months nor six months in its making nor is any other part of it than the so-called concentrate aged six months or any definite period of time.

The Commission held that the representation regarding the age of the beverage tended to deceive the public and divert trade from competitors and furnish to wholesale and retail dealers the means by which they are enabled to mislead customers into believing that the ginger ale is six months old when offered for sale.

Court Bans Tax on Radio Owners

A SWEEPING decision prohibiting taxation of radio receiving set owners, as proposed by a South Carolina law, has been handed down here in the Federal District Court, in the first test case brought at the instance of the Radio Manufacturers Association.

An interlocutory injunction against enforcement of the South Carolina law was granted by the Federal Court and restrains collection of the proposed taxes on radio receiving sets. The decision was made by three Federal judges, Circuit Judge Parker of North Carolina, and District Judges Cochran and Glenn of South Carolina.

The Court's decision was made in the test case of a North Carolina broadcast station, WBT of Charlotte, which contended that radio is interstate commerce and not subject to taxation by a state. The Court's decision sustained the contention that the South Carolina law is unconstitutional as an interference with interstate commerce and cannot be enforced.

The South Carolina law, passed last year, proposed to levy on owners of radio receiving sets a graduated tax ranging up to a maximum of $2.50 per set. It was the first state law against owners of receiving sets, and therefore the decision of the Federal Court is an important precedent in radio law. The WBT case was one of three attacks made upon the South Carolina law at the direction of the Radio Manufacturers Association in the interests of the radio owning and buying public, as well as the radio industry.

Wooden Candle Mark

IN ex parte Saint Louis Candle and Wax Company, First Assistant Commissioner Kinnan held that the company, of St. Louis, Missouri, is not entitled to register, under the Act of 1905, the notation "Waxwood" as a trademark for candles.

The ground of the decision is that, it appearing that these candles have cores of stiff material embedded therein, the mark is descriptive if that core is made of wood.

In his decision, the First Assistant Commissioner noted that the examiner objected to a description of the goods as candles as being indefinite and that description was amended to state that the candles were made of or comprised of wax, paraffin, or similar substances, and was subsequently modified to state that the candles had cores of stiff material embedded therein.

With reference to the question of descriptiveness he said:

"It is deemed self-evident that if these candles are made of wax and have wooden cores, the notation which but recites the names of these two materials is merely descriptive of the goods and its registration is barred by the statute. If the cores are made of material other than wood the notation would not be descriptive."

In his statement the examiner called attention to candles which had been purchased at various department stores which comprised a wooden core covered with wax. The First Assistant Commissioner sustained the applicant's objection to the consideration of these candles as showing the descriptiveness of the term since nothing had been submitted to show that any of the goods were on sale before the alleged date of adoption and use of the mark by the applicant.

Motion Picture Houses Increase

THE United States has more than half of the sound film theatres of the world, and more than a third of the silent and sound houses combined, according to a statement by the Department of Commerce, published in *The United States Daily*.

The first compilation of statistics on sound-equipped theatres by the Motion Picture Division revealed that the world's total was 19,894 and the total for the United States, 12,500, on January 1. The number of movie theatres in the world, it was stated, was 62,365 at the beginning of 1931, and the United States has 22,731. These figures show a 11 percent gain for this country in the number of motion picture houses in the last year.

The world's movie theatres numbered 57,743 at the close of 1929. There was a gain of about 42 percent in the number of theatres in the Near East, with the number increasing from 52 to 74. The increase amounted to 24 percent in Latin America.

Delay Voids Patent

A DELAY of nearly two years in filing a disclaimer as to a claim in a patent after such claim, by interlocutory decree, had been declared invalid by a District Court, is such an unreasonable delay as to void the patent, the Supreme Court of the United States held in the case of Enstein et al. v. Simon, Ascher & Company.

The opinion, by Justice McReynolds, explains that "under the early accepted general rule a patent with an invalid claim was wholly void, and this defect barred suit upon it. Congress undertook to modify this by sections 7 and 9, Chap. 45, Act of 1837."

Voice Culture Advertising Subdued

AN order was recently issued by the Federal Trade Commission to Perfect Voice Institute, Chicago correspondence school, and T. C. Cooke, its president, to stop representing, among other things, that every student can have a *beautiful speaking or singing voice* by developing a certain muscle and taking simple exercises.

The primary cause of strong and weak, and of perfect and imperfect voices, lies in the development and control of the hyoglossus muscle, so it was represented and *taught in the course of instruction* furnished by Perfect Voice Institute. It was further represented that the system of instruction had been proved by every law of physics, anatomy, mechanics, and mathematics, and had shown itself to be infallible in practice by tests on thousands of students all over the world.

An alleged post mortem examination of the throat of Caruso, showing a wonderful development of his hyoglossus muscle, proves, according to Cooke, the amazing truth of the Feuchtinger discovery of the true functions of the hyoglossus muscle. It took Caruso *many years instinctively* to control his hyoglossus muscle, but in the end he became the greatest singer of the century, it was advertised.

The Commission found that there had been no post mortem examination of Caruso.

Every student's throat is constructed exactly like that of Caruso and other world famous singers, with just one exception: they had developed their hyoglossus muscle, according to the Perfect Voice Institute. The main difference between the normal vocal organ of the student and that of Caruso lies in the control, strength, and development of the hyoglossus muscle, the institute declared.

The Commission found that the hyoglossus muscle serves no possible function in voice tone production. It is one of a large group of swallowing muscles intimately connected and its isolation or separate development is physiologically impossible. Its function is to depress the tongue and draw down its sides so as to render it convex from side to side.

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Formerly Munn & Co., Inc., 24-26 West 40th Street, New York

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Subscription price $4.00 per year. Foreign $5.00.

SCIENTIFIC AMERICAN

Owned and published by Scientific American Publishing Company; Orson D. Munn, President; Louis S. Treadwell, Vice-President; John P. Davis, Treasurer; I. Sheldon Tilney, Secretary; all at 24 West 40th Street, New York, N. Y.

EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

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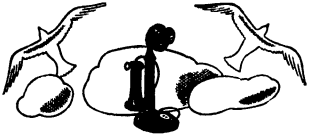
THIS MONTH'S COVER

The cover picture shows a party of geodetic engineers of the United States Coast and Geodetic Survey occupying a mountaintop triangulation station in Alaska. The methods employed and the instruments used in this kind of "super-surveying" are far more refined than those demanded in ordinary surveying. The umbrella shades the theodolite from the sun's direct rays, the heat of which would cause unequal expansion of the parts of the surveying instrument, thus making impossible the accuracy required in the measurement of angles involved in exact triangulation. The opening article in this number describes this kind of "precise" surveying. Its author, the government official in charge of many other kinds of refined surveys besides triangulation, has not mentioned that these surveyors are the very "royalty" of the surveying profession; in fact, they are to be regarded as scientists engaged in field work.

THE UNSEEN

COURIERS

OF THE SPOKEN WORD



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ACROSS THE EDITOR'S DESK

It does not surprise us greatly when some widely traveled scientist or engineer tells us that Scientific American is the one magazine he can be sure of finding in every corner of this old world of ours, for our records show our wide distribution. We might be blasé and say that it's a commonplace thing for a King and a Crown Prince both to be so interested in the same article in Scientific American that we get a request for an additional copy of the issue containing the article so that both may have a copy. We *could* be so blasé, but we won't. The request was really quite unusual, and just as interesting.

Mr. K. S. Twitchell, an American engineer who is now a sort of general advisor to the government of Yemen on the Red Sea, sent the request. He wrote: "I shall greatly appreciate it if you will send a copy of Scientific American, issue of February, 1931, to:

Crown Prince Ahmad Saiff-al-Islam
Hajja, Yemen,
via Aden, Arabia.

"Prince Ahmad was extremely interested in my copy of this issue but I had already promised it at Sanaa to His Majesty The Imam Yahia. The article in which they are most interested is 'Preparedness for Peace.' This country (Yemen) is in the same position as we are, in that they do not wish to make any aggressive war but they do wish to be thoroughly able to defend themselves."

◆

A few words more should be said about the author of the article entitled "Triangulation" which appears as the "lead" in this number and which furnished the subject for our cover painting. In addition to being Chief of the Division of Geodesy of the United States Coast and Geodetic Survey, Major Bowie has been president of the International Geodetic Association since 1919, and is ex-president of the Washington Academy of Sciences.

◆

"What shall we eat?" is the theme of an article in our next issue that is symbolic of modern advancement in an all-important field—that of food and food distribution. In the old days—not so long ago—meats and fish, frozen for shipment by old methods, tasted anything but fresh when they reached our tables properly cooked; and obtaining fresh summer fruits in January in northern cities, if we except hothouse varieties, was unheard of. Now, however, quick-freezing methods give us throughout the year fish, meats, and fruits that may have been stored for months and shipped perhaps thousands of miles, yet are still really fresh to the taste. The trick is in the methods of freezing and shipping which promise to have a decided influence on our eating habits and, as naturally follows, on our health.

◆

The puzzle of the origin of man in America is still so mystifying, despite the many theories advanced, that archeologists are now attempting to enlist the aid of laymen in the study. Human bones and artifacts, literally millions of them, that have been uncovered by excavators of wells, house foundations, and the like, and by curio seekers, have been lost to science because any relic of this sort is valueless for study unless it is accompanied by an authentic record of its discovery. Therefore, while we do not expect our article on the subject in our July issue to make amateur archeologists of even a tenth of our readers, we do know that it will give them all a new understanding of the importance of this work.

◆

Capturing the imaginary yet most desirable "Blue Ribbon of the Atlantic," the record for speed plus a reputation for super-luxuriousness, has become a point of national pride with several large steamship lines. Cunard held this "ribbon" for many years with the *Mauretania* until the North German Lloyd won it with the *Bremen* and the *Europa*. Now Cunard is after it again with a monster liner on the ways. David Masters, the well-known British writer, will tell in our July issue many interesting facts concerning the complex problems that have been encountered by the designers of this Cunarder—which so far is called simply No. 534—and the unique solutions of some of them.

◆

Among other articles to appear in our July issue, there is one on radio beacons for aircraft which was written at our request by two government experts. This article is the last word on the subject which means so much to airplane safety. We find also on our schedule the story of the important but little known Kettleman Hills oil field. This should really be called a "gasoline field" for its wells throw up, not petroleum, but natural gasoline that is practically pure enough to use immediately in the family car. It also produces millions of cubic feet of gas daily, most of which is intentionally wasted to the air.

Orson D. Munn

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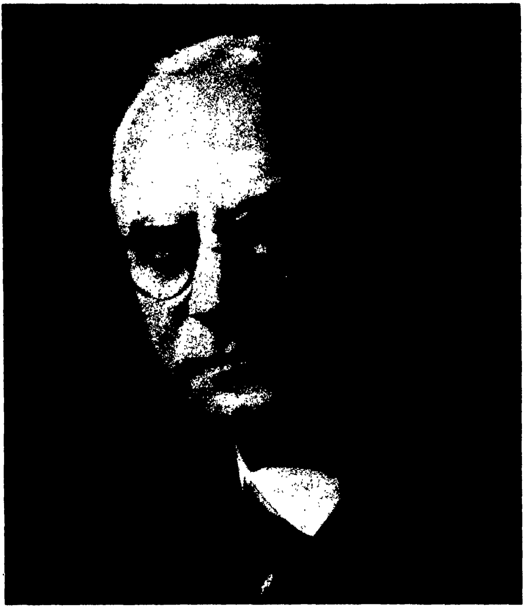
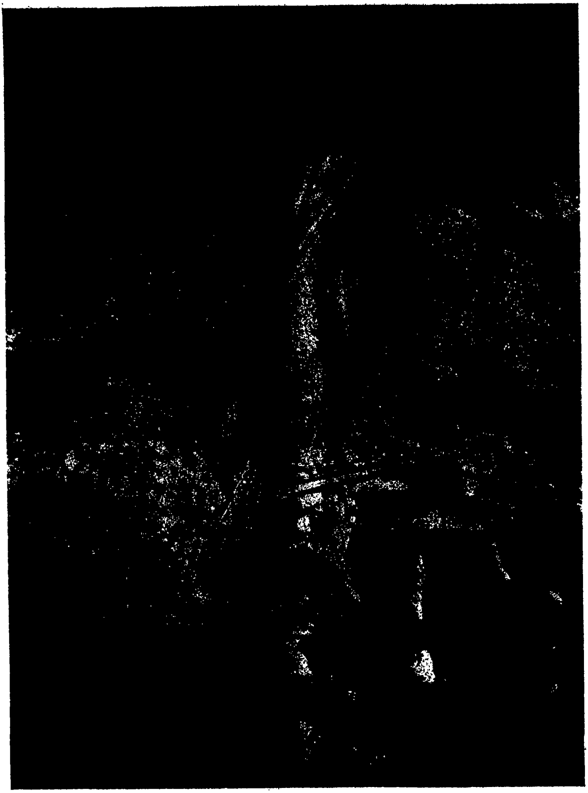


Geo Eastman

FEW attain outstanding success merely because they possess some single, even though outstanding, "genius" quality, but success usually follows from the possession of a rounded, balanced combination of fairly well developed asset qualities. It is not likely that the world ever would have heard of George Eastman and his famous Kodak had he been merely an inventor; or merely a manufacturer; or merely a good salesman and business man. But he was all three.

Fifty years ago, long before modern industrial principles were being talked about, Mr. Eastman translated the mass production idea into practice and combined with it what are now seen to have been advanced ideas concerning advertising. He also saw the dollars-and-cents value of calling in technical experts-- scientific men—and facilitating their kind of research.

Within recent years Mr. Eastman has devoted much energy to the simplification of the calendar. If a shop machine were seen to be as inefficient as our calendar any business or industrial man would say "Junk it," and design a better one. The newer machine, when available, would cause its operator a few days of inconvenience, but when he had learned its levers he would wonder how he ever put up with the discarded relic. So with the calendar. Mr. Eastman contributes to the present number a thought-provoking but not provocative article on this sometimes warmly debated subject.



MODERN METHODS IN THE FORTRESS CITY OF PALESTINE

THE great mound of Armageddon (or Megiddo), once the strongest fortress city of Palestine, commands the most famous battlefield of the ancient world. It is being excavated, if we may be allowed the term, under the direction of Dr. Breasted, Director of the Oriental Institute of the University of Chicago. Modern methods such as contractor's railways, dump cars, and iron chutes for excavated material are used. It is expected that in time the great mound will yield historical monuments of the greatest importance. The plain of Megiddo was the scene of one of the great victories in the World War

A triangulation station on the coast of Alaska, erected by the United States Coast and Geodetic Survey. Along the coast, islands and bluffs may be used for this purpose. The target shown, constructed of wooden poles, is for a short line

TRIANGULATION

How it is Done and What it is For

By **WILLIAM BOWIE, Sc.D., C.E.**

Chief, Division of Geodesy, United States Coast and Geodetic Survey

THE day has long since passed when we could carry on the industry of this country with the oxcart, covered wagon, the canal-boat and the sailboat for transportation, and with the strength of the man and the horse for power. We now have railroad trains, automobiles, auto trucks, air-ships, and steamships for transportation; for power we have great steam and hydro-electric plants which carry power even to the farm and home. The changes in one hundred years in the manner of carrying on our various activities are tremendous and revolutionary.

These developments in our industry and commerce have made necessary changes in other activities, among which are surveying and mapping. The day of the compass and chain has passed. We now use the theodolite and invar base tapes for determining geographic positions, distances and directions. We have substituted the topographic map for the simple route maps or sketches of our forefathers.

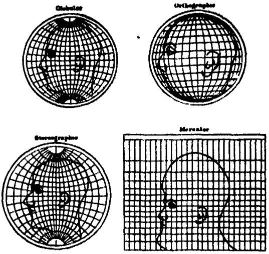
Triangulation is classed as higher surveying. It is based on the mathematical principle that when two angles and the length of one side of a triangle are known, the other angle and sides can be computed. In practice, the length of one triangle side and all three of the angles of a triangle are measured.

The curvature of the earth's surface and the dimensions of the earth must be taken into account when applying triangulation to surveying and mapping problems.

The determination of the dimensions of the earth, or what is usually called its "figure," really depends upon distances measured across the earth's surface by triangulation and the astronomically determined latitudes and longitudes of some of the triangulation stations. When we speak of the figure of the earth we have in mind the surface of the waters of the oceans and of sea level canals extended in imagination through the continents, and not the actual solid surface. There is a good reason for the earth's surface to be irregular and this question will be treated later on. If the water's surface were a perfect sphere, the measurement of the distance between two points on a meridian a degree apart would enable one to compute the circumference and diameter of the earth. Since the meridianal section of the earth is close to an ellipse, it is necessary to have three points on a meridian whose latitudes have been determined by astronomical observations and to measure the distances of one to another. The resulting data will be sufficient for the determination of the figure of the earth.

THE latter is the way in which the early determinations were made. Many determinations of the figure of the earth have been made and most of them have been used in surveying and mapping. The international figure of the earth is the one obtained by the engineers and mathematicians of the United States Coast and Geodetic Survey about 20 years ago. In that work the effect of the irregular surface of the earth on the directions of gravity to which the astronomical observations are referred was taken into account. Measurements within the area of the United States, only about 3,000,000 square miles in extent, were used to obtain the dimensions of the whole surface of approximately 197,000,000 square miles.

The United States, Canada, and Mexico are using the spheroid, or figure of the earth, which was derived by A. R. Clarke, in 1866. This is sufficiently accurate for all practical purposes. These countries are working together in their mapping and charting activities and even have adopted as the initial point for the surveys, maps, and charts of North America the triangulation station called Meades Ranch in central Kansas.



It is impossible to show any large part of the earth's surface on a map without some distortion. The earth's surface is curved, while the map is a plane. There are many systems of showing the parallels of latitude and meridians of longitude on a map, each system being designed for some special purpose. A face shown on one projection will be distorted when the features are transferred, point by point, to some other. Only a globe *is really true to fact*

There are two important phases to triangulation; first, how is it done; and, second, what is the practical value of the results obtained?

Anyone can execute triangulation, but it is only with special instruments in the hands of the experienced engineer that the most accurate results are obtained. Without instruments one can determine the height of a tree by triangulation. First, he draws on a piece of paper or board a right-angled isosceles triangle, then he moves off from the tree to such a point that when one of the short sides of the triangle is held in the horizontal position, the long side, or hypotenuse, will be pointing to the top of the tree. Next, he paces or measures otherwise the distance from the point of observation to the foot of the tree. This distance added to the height of his eye above ground will give him the height of the tree. Of course, this is a rough determination, but the same principle can be applied when using a surveyor's transit. In a manner somewhat similar, the distance across a river may be determined, but here the triangle must be held horizontally rather than vertically.

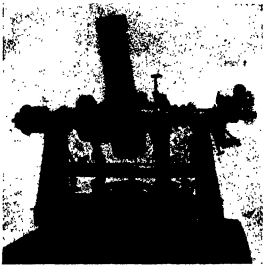
With a small astronomical instrument, chronograph, chronometer, and radio set, the engineer can determine within 20 or 30 feet his longitude and latitude by observations on the stars. The determinations of geographic positions by astronomical observations are used in placing a triangulation net over a country

The Coast and Geodetic Survey began doing triangulation work in 1816, just after it was organized, and except for a brief period during which the coast surveys were discontinued, this old bureau of the Government has been executing triangulation continuously. The first work was done on Long Island as part of the charting of the water surrounding that body of land. During the past hundred years, triangulation has been extended along our Atlantic, Gulf and Pacific Coasts, and all of our charts, used by navigators, are based on the triangulation data secured. About 60 years ago the Coast and Geodetic Survey began the extension of arcs or chains of triangles into the central portions of the country.

Before triangulation can become an effective method of surveying, the latitude and longitude of some point, which is to be used as an apex of a triangle, must be determined from astronomical observations. Then the true direction of a side of a triangle extending from that point must be obtained from observations on *Polaris*—the North Star. The engineer must also select some figure of the earth, for otherwise it would be impossible for him to compute his latitudes and longitudes.

The other operations involve the measurement of the length of a triangle side as a base and of the angles of the triangles. Before 1900, most of the bases of the world were measured by means of short metal bars. The work was very laborious and costly; besides, it was difficult to find ground which was smooth and level enough for a base. The bases vary in length between four and fifteen miles and such distances over very even ground are difficult to find in many parts of this country.

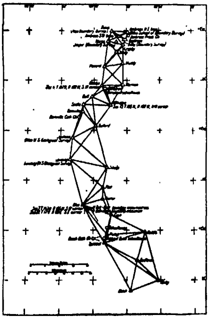
THE problem of the base was solved by the use of long metal tapes. It was found that with steel tapes, 50 meters in length, satisfactory results could be obtained when measurements are made at night or on cloudy days. Good work could not be done with these tapes on sunny days, for then the thermometers used during the measuring did not truly indicate the tape temperatures. An error of 1° Centigrade makes an error of one centimeter in one kilometer, or one part in 100,000 of the length measured, while the required accuracy is greater than one part in 300,000. Steel tapes were used until 1906, when the nickel-steel alloy called "invar" was substituted. Since that date all of the bases have been measured with the invar 50-meter tapes. The coefficient of expansion of the invar used is less than one tenth that of the steel tapes, and bases can be successfully measured with the new tapes, even on sunny days. The probable error of a modern base length is seldom greater



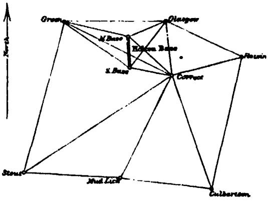
This instrument, a transit, is used for determining the latitude and longitude by observations on the stars. The same transit is also shown above, to the right than one part in 1,000,000. The base is measured at least twice with different tapes to avoid undiscovered blunders and the mean of the measures is accepted as the length of the base.

The separate tape lengths are corrected if there is any inclination from a horizontal direction. The tape is supported at the ends and at the middle point and a constant pull is applied. The tapes are standardized at the National Bureau of Standards, both before and after the field measurements are made. The same number of supports and the same tension, or pull, are used in standardizing as during field work. The average elevation of the base is determined and a correction is then applied in order to reduce the measured length to the sea level surface. No close accord in the triangulation results could be obtained unless the sea level surface, a mathematical surface or figure which closely approximates a sphere, is used. Along any arc of triangulation, bases are measured at intervals of about 150 miles to serve as checks on the lengths computed through the triangles.

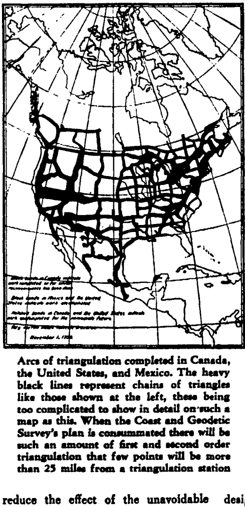
The triangulation of the first order, all of which is now done by the Coast and Geodetic Survey, forms the framework for all other classes of triangulation and necessarily it must be executed with extreme accuracy. The highest type of theodolite is used in the angle measurements, and the objects observed upon it be well defined and perfectly centered over the station marks. In general, an engineer can complete his observing at a station within two hours. The telescope is accurately pointed over each of the triangle sides radiating from a station and after each pointing the direction of the telescope with respect to the accurately graduated horizontal circle of the theodolite is read by means of two micrometer microscopes. The difference between two such sets of readings furnishes a measure of the angle formed by two triangle sides. In order to reduce the effect of the unavoidable errors of pointing the telescope and reading the circle, there are 32 measures of each angle. The average of the separate results is used in the computations.



Triangulation is extended in great chains of triangles over a country. The arcs follow lines of easy communication in order to reduce the costs. Connections are made with church spires, section corners, and state, county, and national boundary monuments, also any other



How a triangulation is started. A line is measured with great accuracy. This is the "base line"



Arcs of triangulation completed in Canada, the United States, and Mexico. The heavy black lines represent chains of triangles like those shown at the left, these being too complicated to show in detail on such a map as this. When the Coast and Geodetic Survey's plan is consummated there will be such an amount of first and second order triangulation that few points will be more than 25 miles from a triangulation station

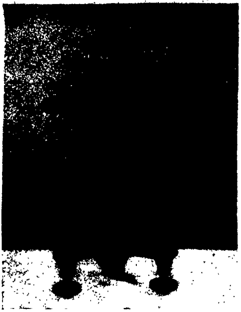
On the first order triangulation, the observations are made at night on the lights of electric lamps. Automobile headlights having special contracted-filament bulbs and with common dry cells for the electric current are employed. The lights are visible to the unaided eye for many miles in clear atmosphere. Two such lamps were used at station Ords in Arizona and the observer at station San Francisco Peak saw the light though the distance between the stations was 153 miles. It is only in mountainous regions that the lengths of the triangle sides are more than 40 miles. Some subsidiary observing is done during daylight and then heliotropes are used as the objects to be pointed on. The longest triangle side over which the sun's rays reflected from a heliotrope were observed was 192 miles. The side was between Mount Shasta and Mount Helena in California.

In flat country or where the hills and ridges are heavily wooded, it is necessary to elevate the theodolite, lamp, and heliotrope to such heights that the lines between stations are clear. For this purpose a steel tower is used. This tower can be erected to any height up to 146 feet. When the engineer selects the station along any proposed route he estimates the height of the tower needed for each of the stations. The top of the tower is accurately centered over the station mark by means of a special instrument, called a vertical collimator. The tower was designed by J. S. Bilby, Chief Signalman of the Coast and Geodetic Survey, with the assistance of the designing engineer of the Aermotor Company of Chicago.

Prior to 1927 the towers were made of lumber, but the lumber in a tower could not be used a second time and, besides, the erection of the wooden tower required much more time than does the steel tower. Five men can erect a steel tower 103 feet in height in five hours. A triangulation party uses either [illegible] or twelve towers. When observations on a tower have been finished, it is taken down and carried forward by trailer trucks to another station.

The plans for the triangulation net of the United States call for arcs of first order (the highest class) spaced about 100 miles apart, with some cross arcs to be used in the adjustments by the mathematicians at Washington. Through the intermediate areas there will be run arcs of the second order. When the work has all been finished—some 12 years from now at the present rate of progress—few places will be more than about 25 miles from a fundamental station. This is the federal project. The spaces lying between adjacent federal arcs will be covered by third order triangulation for use in detailed mapping and surveying. This will be state or county work or federal work done in co-operation with the states by previous arrangement.

It is impossible to over-estimate the value to a country of good maps, and triangulation of the first and second orders plays the same part in the maps that the steel frame does in the modern skyscraper. Without the steel the structure could not be erected, while without the triangulation the maps would be a jumbled mass without accuracy in area, distance, or direction.



The standard theodolite used by the engineers of the Coast and Geodetic Survey on first-order triangulation. It was designed by D. L. Parkhurst, Chief of the Instrument Division of the Coast and Geodetic Survey and constructed under his direction. The average correction to an angle in the adjustment is about one half second. This corresponds to only one foot at a distance of 80 miles. The instrument is rapid in its operation

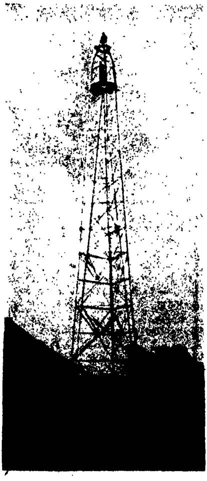
The 47,000,000 square miles of land area of the earth is all we have. There are about 2,000,000,000 human beings on the earth, more than 40 per square mile. Some areas are very densely populated, while in others, like the deserts, there are few persons. Much of the land is extremely cold and practically uninhabitable. Many of the great wars of the world have been fought over the possession of the desirable land. Land has a scarcity value—none can be made. As the population of the world increases, land will become increasingly important.

A piece of land is valuable in proportion to its capability to supply food and other products useful to man. Would it not be well if the governments of the nations of the world would map their areas and then make studies which will lead to definite and complete knowledge as to their natural resources? This would certainly seem desirable. Many areas are now mapped but much remains to be done. At present about 44 per cent of the area of the United States has been covered by topographic maps. Recently there has been a speeding up in the mapping program from which industry and commerce will greatly benefit. Triangulation is the basis of this mapping for the triangulation stations furnish the latitude and longitude of many stations used in the topographic mapping.

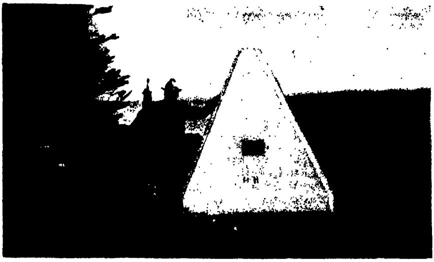
The first order triangulation net will soon have arcs close to all the coast lines of the country, thus insuring perfect coordination of the coastal charts and the interior maps.

Two adjoining nations are fortunate if their common boundary is defined in unmistakable terms. Wars and rumors of wars are often due to disputes over boundary lines. Fortunately for us, we have avoided boundary wars, although we have had a number of serious boundary problems. Many will recall the Alaska-Canada boundary problem, which was peacefully settled. It had been troublesome for many years.

Many of the states of this Union have had boundary problems, some running back to the time the states involved were created. All of these problems have not yet been settled. The causes of the trouble can in most cases be traced back to the absence of maps or to poor maps when the boundary was originally defined. The boundary may be defined as "the center of the main branch," the "north fork," or the "south fork" of a



Two views of the Bilby tower, used at different heights, shown at left and right. Usually it is used at 103 feet in elevation; even in flat country the curvature of the earth requires this on long lines. The tower consists of two entirely separate structures, the inner one to carry the theodolite and the outer one for the observer, thus avoiding bad effects from jarring. The outer one also supports a signal lamp



A monument at Passamaquoddy Bay, Maine. To it is referred a point on the United States–Canadian boundary, which is out in the middle of the bay. Triangulation is of decided value in locating various political boundaries

certain river. A correct map may show that it is impossible to decide definitely what part of a river system conforms to the boundary description.

If the boundary between two countries or states is defined in latitude and longitude, there will never be any serious question as to its exact location. If located by astronomical latitudes and longitudes the places where the astronomical observations are to be made should be decided upon and described. The astronomical determinations of latitude and longitude are affected by the irregular terrain and in consequence a north and south boundary may be a very irregular, rather than a straight line. Some of the boundaries of our western states show the effects of astronomical locations. However, in no case is the boundary much affected. A half-mile is about the maximum effect of the terrain on an astronomical location. But even this is more than enough to cause trouble between two states or nations.

A CASE in point is the boundary between Oklahoma and Texas. It is defined as lying in longitude 100° west of Greenwich. Three astronomical locations of the boundary had been made and there were three lines on the ground. The outside ones were separated by a strip several hundred feet in width. This was due to the fact that the astronomical observations were made at different places for the several lines. A few years ago this boundary dispute was taken to the Supreme Court, the final arbitrator in state boundary contests. The Chief Justice ruled that the boundary should be placed on the 100° meridian by the best scientific methods. The Commissioner appointed by the court requested the Director of the Coast and Geodetic Survey to have an arc of first order triangulation extended along the proposed boundary. Since the longitude of each station is determined by triangulation, it was an easy matter for the Commissioner to measure short distances to the east or to the west of the stations in order to get exactly on the 100° meridian. This is probably the most scientifically defined and established political boundary in the world.

At each triangulation station an inscribed bronze tablet is set into out-cropping rock or in a block of concrete. This monument is placed directly under the center of the top of the Bilby tower. The theodolite and lamp must be placed directly over the mark. The stations are established for the use of surveyors and engineers and therefore the mark must be substantial, permanent, and easily found and identified

While a single astronomical station may be seriously affected by the terrain, yet the average of hundreds of such stations will be very close to the true latitude and longitude. It is for this reason that the latitudes and longitudes of places determined by triangulation are free from the influence of the irregular surface of the earth. The many astronomical stations of the country were used in obtaining the theoretically best latitude and longitude of the triangulation station at Meades Ranch, Kansas, the starting point for all of the triangulation of North America.

The old chart of the island of Porto Rico, which was based on the astronomical stations at Ponce on the south coast, and at San Juan on the north coast, was too wide by nearly one mile. The directions of the plumb line at these stations were affected by the island mass and the deficiency in mass in the adjacent seas.

IT is evident that one cannot use a single astronomical determination of latitude and of longitude, or even such determinations at a small group of stations as the basis for a chart or map or for the basis of a political or other property boundary. It was by means of triangulation that the error of the old chart was discovered.

With land becoming more valuable as the years go by, the private property owner is demanding a more rigid and definite establishment of his boundary lines. The strongest method is to have the boundary monuments connected with the triangulation system of the country. This can be done directly should a triangulation station be located near the property. Otherwise, the connection can be made to traverse stations which have previously been connected with triangulation stations. When such connections have been made, it will be possible to recover very accurately the corners of the original boundary should the monuments be destroyed.

During the past decade the triangulation of the Coast and Geodetic Survey has been expedited by the use of automobile trucks as a means of transportation. From truck to mountaintop the instruments are carried by men or pack animals

OUR POINT OF VIEW

The Nicaragua Canal

THE question of the feasibility of the proposed Nicaragua Canal has assumed an increased controversial importance since the city of Managua was destroyed by earthquake early in April. Opponents of the canal say that such an earth movement would destroy such an engineering work but its proponents say there is as much likelihood of a disastrous quake at Panama as there is of a repetition of the one in Nicaragua.

It is, therefore, time for a few pertinent facts. Panama Canal traffic has been declining since 1928; it has not increased in the straight-line curve that was so firmly predicted for it a few years ago. Accurate analyses by several authorities indicate that the traffic peak will not reach the Panama Canal's present capacity of 60,000,000 tons for years to come. Completion of the Madden Dam and of a third set of locks will raise this capacity to 143,000,000 tons and it is conceivable that this capacity can handle all trans-Isthmian shipping for 75 to 100 years. Long before that time has elapsed, the horror of the Managua quake will have been practically forgotten in a region where quakes are almost as frequent as changes in the weather and engineering practice will doubtless have been improved to the point where nothing short of a major earth movement will be feared.

At present neither proponents nor opponents of the Nicaragua Canal have much to worry about. Both may talk all they please and enjoy themselves to the utmost. The rest of us will sit back content with the knowledge that the government is not going to spend 700,000,000 dollars for a second canal until it is definitely needed—and that may be years hence.

The "R-101" Disaster

AFTER five months of investigation, Sir John Simon and his board of investigators reported, late in March, their unanimous opinion that leaking gas caused the crash of the airship *R-101* over Beauvais, France, on the night of October 4, 1930, while on a trip to India. Leakage of gas from one of the forward gas cells was thought to have followed the ripping by the storm of the forepart of the outer envelope.

Particularly interesting is that part of the report which reads: "She (the *R-101*) had never gone through trials which proved by their length and conditions that she was well able to cope with a continuance of unfavorable conditions. . . . It is impossible to avoid the conclusion that the *R-101* would not have started for India on October 4 if it had not been that reasons of public policy were considered as making it highly desirable for her to do so if she could."

In our May issue we described the new airship *Akron* which is being built for the United States Navy and which will no doubt take the air before this is published. She is believed to be the safest airship so far constructed and, according to calculations, could lose all the gas from two of her gas cells and still remain in the air. And yet there are always chances that something may go wrong, and the *R-101* disaster teaches a lesson of caution. It is expected that the Navy will exercise its usual good judgment in the matter of testing the *Akron* thoroughly before formal acceptance.

Truth Will Out

"MEDIUM whose séances baffled scientists quits profession, confessing he is a 'fake'," was the surprising front-page headline in *The New York Times* that greeted New Yorkers one morning in April. Nino Pecoraro, for years a "successful" medium, was the confessor. He admitted that his seemingly supernatural accomplishments were all a fake, and said, according to the newspaper, "I'm sick and tired of giving séances and having others reap the profits."

Reference to the book "Our American Adventure," by the late Sir Arthur Conan Doyle, shows that while on a visit to the United States in 1922, Sir Arthur attended a séance given by Pecoraro and was convinced of this medium's psychic power. At this séance, there were "two Italian females," Dr. Vecchio whom Sir Arthur described as "a skilled psychic observer and a man of high scientific attainment," Dr. Allerton Cushman, Dr. H. Carrington, a "Persian gentleman named Kervorkian," two unknown young ladies, Sir Arthur, and Lady Doyle. After the *show* had been going some time, Sir Arthur said that "There was a strong cool breeze, a sure sign of the real psychic power," and, commenting on this, said "Do not these psychic air vibrations throw a light on the constant request from spirits that we sing or play and so keep the waves moving?" After vain attempts to converse with a voice that called itself Palladino, a continued billowing outward of the curtains, and much jumping of tables, lasting in all about two hours, the séance was broken up. There was no materialization, so Sir Arthur said that "It was not, it must be admitted, a very successful sitting. . . . I thought the youth was a true medium and might develop into something remarkable."

Our file copy of SCIENTIFIC AMERICAN for the month of February, 1924, gives an account of three séances Pecoraro held that year in an attempt to win the SCIENTIFIC AMERICAN award of 2500 dollars for the production of genuine psychic phenomena. Pecoraro's tricks proved most engaging; in fact, he was so clever that the distinguished investigating board admitted that it could not accuse him of conscious fraud until further sittings had been held. The board finally concluded that he did not produce anything that could not have been produced equally as well by mechanical means.

These are the simple, uncolored facts. Do they not show why science, while not denying wholly the existence of psychic phenomena, has adopted a hands-off attitude on the question of spiritism? It is an emotional study not based on hard and fast facts. The apparent success of some observers is not convincing and science will not be hasty in accepting any of their findings. In view of Pecoraro's confession of his own charlatanry, spiritism has been given a body blow which will make scientists even more skeptical of the genuineness of so-called psychic phenomena.

Why Have A Navy, Indeed!

THE press is continually plagued with letters concerning the Navy written by people who don't know what they are talking about. A recent example appearing in a New York newspaper asked the question "Why have a navy?" and answered with the naive assertion that a navy is wholly unnecessary, having been rendered so by aircraft. Were it not for the fact that, unfortunately, such fatuous remarks often fall on fertile soil and help sway people who form opinions in accord with their prejudices rather than with good judgment, they would excite no more than an amused smile.

In considering this question, let us look only at capital ships and forget the rest of the surface and sub-surface units, for there are certain interesting facts about these vessels that are not generally known. For example, the victory in the recent war games in the Caribbean was attributed to battleships, assisted, of course, by cruisers, destroyers, and airplanes. Next, consider the fact that France, having forsaken capital ships in favor of fast cruisers, destroyers, and submarines, has now reinstated them. Consider, also, that Great Britain is not and has not been in favor of the abolition of battleships, many American writers to the contrary notwithstanding.

There are those who think that one well placed aerial bomb would disable a modern battleship. Such people have evidently not heard that the modern war vessel can continue to function and its main battery to fire after most of the superstructure has been shot away, the fire control of these vessels being far down below the water line in an almost invulnerable position. They are apparently ignorant of the fact that anti-aircraft guns of surface vessels, firing during tests at a sleeve (the would-be bomber) towed by an airplane, have recorded many hits on the target before it could reach a bombing position.

There is no denying the fact that the airplane is a valuable adjunct to the fleet. This is indicated by the efforts of the naval powers to discover the most effective method of utilization of aircraft. Not content that aircraft carriers represent this ultimate method, the powers are working out plans for new experimental types of ships, of which the "flying-deck cruiser" is an American example. It is plainly evident, therefore, that aircraft will play a [illegible] creasingly important part with the fleet, but neither they nor any other battle unit will render battleships *obsolete*—at least for many years to come—and the battleship, like a healthy hen, will always have her brood of chicks: smaller ships and submarines.

Sick Railroads

"WHAT is the matter with the railroads?" is a question that has been repeatedly asked during the past year or two. Many answers have been given and analyses made but there is still no let-up to the anxiety of railroad men. However, Mr. Dillon's illuminating discussion of the subject, on page 376, shows, without saying it in so many words, that the public is wholly indifferent to this momentous problem despite the fact that the solvency of the railroads bears a definite relationship to the well-being of the country at large.

To look backward a bit, let us remember that the rapidity of the development of our rich and spacious west was possible because of railroads. In fact no other one thing has made anything like so great a contribution to the progress of the entire nation. At the present time, according to General W. W. Atterbury, President of the Pennsylvania Railroad, the American people hold 18 billion dollars' worth of railroad securities. These are held not only by close to a million individual investors but also by insurance companies and banking institutions. Thus the soundness of the insurance policies of many millions of people depends in part upon the soundness of railroad security investments.

Lessons Learned

SPEAKING of the world's economic troubles a few days ago, someone commented on the spirit of hopefulness that has been manifest in this country during a year and a half of adversity. Few have lost faith in our system although it has become evident that certain adjustments, both national and international, are necessary. As a nation, we still have our prosperity and it remains for us to determine its full significance and its limitations, and reorgan-[illegible] mental processes [illegible] cordingly.

Perhaps the machine *has* contributed to the present unemployment crisis, but that is only because of maladjustment and lack of understanding. Machines will be developed further and that, according to the emotional reasoning that has been rife among the multitudes, will throw more workmen out of employment. But it is not so simple as that; whatever may be the result of progress in machines, the cause may be found only in a correct interpretation of complex economic laws.

It has always been SCIENTIFIC AMERICAN'S mission to supply that interpretation and now, when the world is on the way to economic recovery, we are in the fight with greater earnestness than ever before. There are lessons to be learned from our recent depression and from the scientific advance of industry that may help to prevent a recurrence of world-wide industrial sickness. Our industrial articles will still breathe that spirit of hopefulness that has characterized them in the past, will study the significance of developments and draw from them a moral of progress, will suggest new fields to conquer, will, in fact, provide a constructive service for the thinking man who will be a leader in industry in the new epoch that is inevitably coming.

Professor William Z. Ripley, who is recognized as one of our greatest authorities on railroad economics, stated recently that, "Allowing five to a family, they (the railroads) support directly almost 8,000,000 people." There is [illegible] way of estimating the much greater number who are to some extent supported by them indirectly. Professor Ripley said also that they are "far and away the greatest taxpayers—contributing 500,000,000 dollars annually to the public treasury," and that their purchases amount to a billion and a half dollars a year! And yet commercial motor vehicles are given preferred treatment. For example, motor trucks, which pay a disproportionately small total in taxes, which are free to run when and wherever they choose, and over the operation of which there are no such strict regulations as those imposed on the railroads by the Interstate Commerce Commission, are taking the cream of the freighting business. They are not compelled, as the railroads are, to file their rates and hold rigidly to them, nor to take all the business that is offered them, regardless of whether it is profitable. They can and often do practice the worst kind of cut-throat competition.

It is a well-known fact that railroad men have been conservative; that fact is exemplified in Mr. Dillon's statement that the possibility of automobile competition brought a laugh when mentioned to railroad men only a few years ago. But that is all changed. The railroads are looking to the future, weeding out inefficiency, establishing new high standards, and making great progress in coordinating other forms of transportation with their established systems. The immediate future looks rather black but Edward Hungerford, writing in *Forbes Magazine*, says flatly and positively that the railroad is coming back, that "it is no more to be supplanted by the motor vehicle—or the airplane—than the telegraph was supplanted or put out of business by the telephone."

In view of these facts, the question "What is wrong with the railroads?" becomes "What is wrong with the American people?" The railroads *are* alert to their problem but the people, vitally concerned with the outcome of the fight, forget past loyalties to a public necessity that has never failed them, and leave the onus on the shoulders of railroad executives. The railroads want fair, not favored, treatment. They want their competitors placed on an equal basis with themselves, either by a removal of the restrictions placed on the railroads or by the imposition of similar restrictions on commercial motor vehicles. It is time for a return of confidence in the railroads; we should see that they are accorded the fair treatment they deserve.

OUR CHANGING TRANSPORTATION

By CHARLES DILLON

ABOUT the most depressing document on a railroad executive's desk in the final days of 1930 was a report from the passenger department. Going over its gloomy figures solemnly the president could see little that was cheerful. Competition, long declared to be the life of trade, was and is—at least in the railroad passenger business—having just the opposite effect. Wherever he looked the executive saw the fickle public, forgetful of old loyalties, turning in increasingly large numbers to motor buses, private automobiles, and even to the skyways.*

Railroads are such enormous things, and their various reports have to do with amounts so far beyond human understanding that one finds it easy to excuse the public's casual indifference to the stories it hears of declining profits, taxes of more than a million a day, and other such dreary items. The public has heard so much of this in the last generation, and it has so many troubles of its own, anyway, that little heed is given to the railroads' cry of wolf.

IT SEEMS only a few years ago that the suggestion of dangerous competition from motor cars raised a hearty laugh. It doesn't get a hand today. To mention it in some railroad offices is as risky as breaking the news of another rate cut by the Interstate Commerce Commission. To grasp it understandingly one has only to know that in 1911, which is going back far enough, precisely 619,500 passenger automobiles were registered in the United States. At the end of 1929 there were 26,700,000 automotive vehicles registered, and about 24,000,000 of these were passenger-carrying cars—automobiles or buses. There were 21,400,000 of these passenger cars in 1928. To state it in figures provided by unprejudiced sources, the increase in this form of vehicles between 1911 and 1928 was 3351 percent.

Needless to say, although it is convincingly shown with figures, the passenger business of railroads has decreased alarmingly, and this decrease affects the fortunes of many thousands. Obviously, nothing much can be done about it. The government can regulate and control publicly-owned vehicles as common carriers, but it can do nothing to prevent citizens' riding in whatever kind of vehicle they choose to patronize; and certainly a government can not dictate with respect to privately owned cars. These private automobiles, it should be understood, are the chief competitors responsible for loss of railroad passenger business.

If anyone imagines this passenger decrease has not been impressive, it is necessary only to know that in 1920 the railroads in the United States carried 1,234,862,048 passengers. That was a peak year. From that time to the present, passenger traffic has decreased constantly. In 1928 the number of passengers carried had fallen to 790,327,447. In 1929, the decrease continued. Indeed, the traffic was smaller than in any year since 1909. The loss between 1920 and 1930 was 40 percent.

As the country's population increased more than 16 percent in the last decade and the increase in passenger motor vehicles was so high as to be beyond our comprehension, it seems reasonable to conclude that the people have changed their choice of transportation methods. Certainly, they have not ceased traveling. You get a rather clear view of the situation in dollars and cents when you learn that in 1920 passenger receipts amounted to 1,286,613,000 dollars and that this sum had fallen in 1929 to 874,000,000 dollars. The meaning of this is more understandable if you chance to own railroad stocks or bonds.

What became of all these passengers? The answer to this question is fairly well set down in a careful count prepared during the last summer at the crossing of St. John's River at Jacksonville, Florida. The report was made by experts. Two thirds of the automobiles and passengers had come from "long haul zones." This is the most impressive part of the record:

License Plate	*Cars*	*Passengers*
California	125	304
Illinois	834	2308
Indiana	387	1127
Massachusetts	553	1435
Michigan	920	2611
New Jersey	1385	3836
New York	3208	8601
Ohio	1251	3339
Pennsylvania	1356	3738
Canada	158	475
Total	10,177	27,774

In the count for the month, every state in the union was represented, with Mexico and Hawaii added, and the total, including cars from "short haul" zones, for 31 days was 15,610 cars carrying 42,504 passengers. When one considers how many millions of cars were traveling elsewhere over the nation all summer, every car carrying from one to five or seven passengers, it is not so difficult to understand why the railroads' passenger revenue has declined.

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There is another authentic record that conveys interesting information: the travel to Canada. It isn't anyone's business why they went up there, but the fact is that in 1929 exactly 4,508,808 automobiles entered the Dominion from the United States, or 863,353 more than went there in 1928. If there were two persons in every one of those cars, and probably there were three or four, more than nine million potential passengers for railroads rode in automobiles and spent their money in other ways.

BETWEEN 1923 and 1929, inclusive, 481,289 automobiles entered California at three southern gateways where the record is made every day. These cars carried 1,544,194 passengers. How many entered the state at the northern gateways is not a part of the count; neither is there a report for the number of passengers who traveled on publicly-owned buses. Still later reports show that 633,496 persons from other states went to California by motor car from January 1 to September 30, 1930. During September alone, 76,664 tourists in 29,261 automobiles with licenses of other states arrived in California. These totals are from accurate checks made at 25 inspection stations at the state's borders by the California Department of Agriculture. And what applies to California traffic probably is equally applicable in other parts of the country.

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*See "Our Point of View" in this issue.

For years we have heard it said that motor trucks would get only the short haul traffic, but there is much evidence to contradict this belief. In the society column of a Hollywood evening paper, one day in October, two items attracted special attention from railroad men. One told of the arrival of trucks of a company in New York, with the household goods, the *lares* and *penates*, the paper called them, of the Irish tenor, McCormack; and other trucks bringing the belongings of a lecturer from Kansas City. These are long hauls with a vengeance. Inquiry showed that the uncrated household goods were securely packed in the trucks at the owner's door in New York, and unloaded at his door in Fuller Avenue in Hollywood. The expense of crating, usually as much as the freight bill charged by a railroad, and the high cost of trucking from the house to the railroad station and vice versa, were saved. The shipment came through in good order, without delay except at night, and reached its destination certainly much sooner than any railroad would have found it possible to record.

A TRUCKING company in Los Angeles advertises 15-hour freight service to San Francisco, 480 miles away. This is faster service than railroads offer and the rate is lower. Passenger buses, the finest product of the factories, making very nearly as good time as one railroad's fastest train, will carry you from Los Angeles to San Francisco for less money. The night buses have berths for 15 or 16 persons, almost as wide as a single bed, and passengers may turn in and sleep—maybe. We now have a 28-hour mail and passenger service by air from coast to coast. No railroad train ever will go that fast, and we ought to be glad, too.

Another interesting angle in studying the people's changed attitude toward transportation of the day is found in the figures, and there are not many of them, pertaining to gains and losses in different classes of travelers. Since 1921 passenger traffic in sleeping and parlor cars has increased 32 percent—the most costly form of transportation except by air—while revenue from passengers in day coaches decreased just 42 percent.

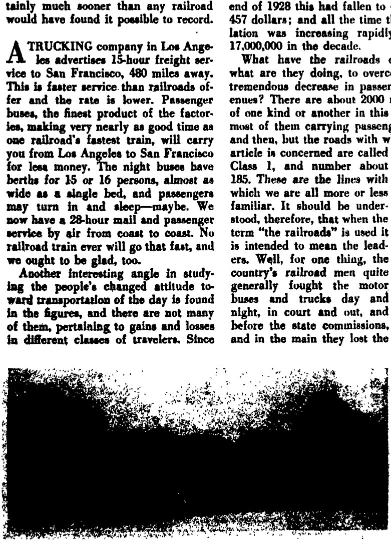
What became of this 42 percent which usually patronized the cheaper facility? Statistical sharps say the absent passengers bought low priced automobiles, new or second hand, bundled the wife and children and the camp equipment therein, and set out happily to "See America First." The 32 percent increase in the sleepers and parlor cars, the sharps say, was made up largely of persons of means, persons able to own one or more automobiles, but not disposed to use them in crossing the continent. This class prefers to travel in the luxury now provided by all the principal railroads.

AS percentages are not particularly enlightening for an evening's reading, it may be better to say that in 1921 the Pullman passengers produced 358,655,902 dollars in welcome revenue. By 1928 this had grown to 438,073,396 dollars. Now look at the other side of the picture: In 1921 day coach traffic was worth 795,402,216 dollars. At the end of 1928 this had fallen to 464,253,457 dollars; and all the time the population was increasing rapidly, about 17,000,000 in the decade.

What have the railroads done, or what are they doing, to overcome this tremendous decrease in passenger revenues? There are about 2000 railroads of one kind or another in this country, most of them carrying passengers now and then, but the roads with which this article is concerned are called Class 1, and number about 185. These are the lines with which we are all more or less familiar. It should be understood, therefore, that when the term "the railroads" is used it is intended to mean the leaders. Well, for one thing, the country's railroad men quite generally fought the motor buses and trucks day and night, in court and out, and before the state commissions, and in the main they lost the decisions, yet the fight went merrily on.

A few far-seeing executives did no fighting. Instead, they entered the bus and truck business themselves. In 1925 only 10 railroads owned motor coaches and operated them in connection with their regular trains. There were 78 such roads in 1929. In 1925 the 10 lines mentioned owned 300 passenger motor coaches. In 1929 this number had grown to 2389. In 1925 the first group had 900 trucks and trailers; in 1929 there were 55 railroads with 5900 such vehicles. But they never have caught up with the automotive industry. True, that industry created an enormous tonnage for the freight department, but this has not overcome the immense losses in passenger traffic, and it has not replaced the millions the roads have spent for new equipment, baby blue upholstery, revolving chairs, radio, valets, manicurists, barbers, tailors, baths, air-cooled dining cars, private rooms in sleepers in addition to the familiar staterooms and compartments, news service daily, library, smoking rooms for women, and so on to the red ink, amid the loud cries of the unfortunate stockholders.

ONCE more, in another way; what have the railroads done to stop the people's drift to other transportation? To buy a few hundred motor coaches, obviously, was a feeble move, but it appeared to be the limit of the railroads' aptitude for overcoming a disaster of such proportions. In the far west some of the roads established low rates for coach passengers only between Los Angeles and Chicago. The result has not been exhilarating. Traffic volume in-



Transcontinental travel: *left*, years ago; and *right*, today in the sleeping cabin of a new Fokker air yacht with seats for 16, a kitchen, and full dining service creased immediately, but revenue declined. It took money to provide modern, comfortable, reclining chair cars for those low-rate passengers, and the fares they paid for riding and sitting up a couple of nights did not pay the bills. Railroads may make money with their motor-bus adjuncts, they say, but will not make enough to overcome the losses in coach traffic.

Valet service is one of the many "luxuries" of railroad travel adopted to attract more fares

What is the answer to all this? No one has it. If all roads should reduce fares to pre-war levels of 2.5 cents a mile against the present rate of about 3.6 cents, as some have already done, the treasuries might suffer, but at least the railroads would know whether they could fairly hope ever to win back lost business.

Late last fall various traffic officials began talking about a reduction of 33 percent in fares, realizing that this would require an increase of 50 percent in volume. Before the end of December western roads in several instances had announced a return to the pre-war passenger tariff of 2.5 cents and in some cases to two cents a mile, station-to-station, one-way *intra*state fares. Such reductions needed only the approval of state commissioners.

THE experiment revived the old classic about the customer who asked a clothing dealer how he could afford to sell suits at less than cost, as advertised. "Because," was the reply, "I sell so many of them."

This rule will never apply, however, in selling railroad tickets. It takes more coaches to carry more passengers and this, in its turn, means more locomotives and more crews with the highest wage scales paid anywhere in the world for such labor.

Still another experiment became effective January 1 on several lines, mostly in the middle west, and was announced only for a six months' period. This is really an adoption of European classifications in which the three classes of passenger rates are the standard sleeping car rate, tourist sleeping car rate, and day coach rate. The usual fare affecting all passengers was to be continued in force as the standard rate. Persons who ride in tourist cars were to pay 15 percent less for their tickets than those who traveled on the standard rate, while the day coach rate was to be 24 percent less than the tourist rate. The new rates affect passengers boarding trains at terminals and at many intermediate points. This, of course, is an interstate arrangement.

Speed has little to do with the railroads' problem. Railroad trains are running about as fast now on the principal lines as experienced managers believe necessary and safe. The trip from Chicago to Los Angeles can be made in from 54 to 65 hours with all modern comforts. Compare this with the travel of 60 years ago, or contrast it with most of the railroads of Europe, and no very great fault will be found with American facilities.

The first passenger train between San Francisco and Chicago, in 1869, made the trip in 126½ hours, about twice the time required today. First class fare in those days from San Francisco to Chicago was 130 dollars; to New York 150 dollars; to St. Louis 129 dollars—a strange division of rates it seems. Now the fare from the Pacific Coast to Chicago is $79.84 with $23.63 added for a lower berth or $18.90 if you don't mind climbing into an upper. Against this present-day price are low fares charged by motor transport, which runs de luxe coaches clear across the continent. Such a journey has few attractions for persons accustomed to luxury, but nevertheless thousands travel that way at least once. The service may leave much to be desired, but it remains a very formidable competitor.

The people of America have turned or are turning definitely from steam railroads to motor vehicles in such alarmingly large numbers as to threaten the continued operation of adequate passenger facilities. Freight traffic in an increasing volume is going to the highways in trucks, to steamships through the Panama Canal, and to the waterways with the government supplying most of the capital from taxation. Pipe lines carrying oil hundreds of miles across the country constitute a further and very appreciable threat against the railroads' freight revenue.

Can steam railways recapture departed passenger traffic by offering tickets for two cents a mile? If this traffic is brought back to the railroads, can they afford to carry it at this pre-war rate and continue the present high wage scales? Can they grant the six-hour day to trainmen, and maintain the wage scales as at present on these low fares?

CAN motor bus and freight truck companies hold and increase their volume of freight and passenger business at rates now very close to, and in some cases below, railroad tariffs?

What will be the fate of air passenger transport now growing in popularity because of lower fares? Air rates now are on an out-of-pocket basis, the service being possible only because of government mail contracts which are, indeed, a fortunate form of subsidy. If air passenger service grows in the future as it is doing at present, how long will it be before the cost of operation and maintenance overtakes the subsidy, and what will happen?

One thing the railroad men say has been proved: Persons with plenty of money never complain about the cost of transportation. Extra fare trains have proved this. Persons of limited means who are in the majority always complain, and then travel in their own automobiles, overlooking what statisticians say is a fact, that no man can motor from New York or Chicago to Los Angeles as cheaply as he can ride on a railroad train.

If the present trend from the railroads continues toward other forms of transportation, is not the country confronted by the danger of government ownership?

A Nitecoach transfers its passengers to a transport airplane. Here are shown together two of the railroads' most feared competitors for passenger business

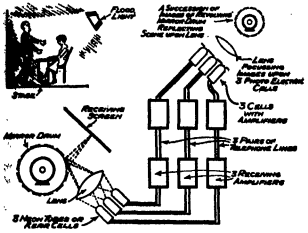

FLOOD LIGHT
A SUCCESSION OF IMAGES OF REVOLVING MIRROR DRUM REFLECTING SCENE UPON LENS
LENS FOCUSSING IMAGES UPON 3 PHOTO ELECTRIC CELLS
STAGE
RECEIVING SCREEN
3 CELLS WITH AMPLIFIERS
MIRROR DRUM
3 PAIRS OF TELEPHONE LINES
3 RECEIVING AMPLIFIERS
LENS
3 NEON TUBES OR KERR CELLS

Diagram of the "zone" system of television transmission and reception, using telephone lines to carry the currents

A laboratory set-up of one of the Baird televisors. The half-tone reproduction is viewed on a translucent screen

ZONE TELEVISION AND THE TELEVISION ARC

By SYDNEY A. MOSELEY

ONE of the difficulties in radio television has been to find a sufficient wave band, and until a solution of this problem is found it will not be possible to transmit images containing a very great amount of detail. Where television in theaters and all places of entertainment is concerned, however, this problem does not arise, as the television program can, if required, be transmitted over telephone lines, where two or more channels are readily available. This type of television may be described as "zone" television, and in the Baird laboratories in England a demonstration of zone television was given recently.

An outstanding point of this demonstration was that the light-spot system has been replaced, and instead of scanning the scene by means of a rapidly moving light spot the scene was subjected to ordinary flood lighting. This is a point of some importance, as ordinary scenes illuminated in the usual way can be transmitted by this apparatus—not only scenes illuminated by floodlight, but also scenes by ordinary daylight. Daylight television was, in fact, demonstrated by the Bell Telephone laboratories in this country, and Baird in England, some time ago.

The apparatus used in the Baird zone televisor consists, at the transmitting end, of a large mirror drum with 30 mirrors arranged around its periphery, each mirror being tilted slightly differently from the next. This is the well-known Weiller mirror drum—a device first described by Weiller nearly 40 years ago. The images cast by the mirror drum as it revolves pass over three apertures so arranged that each aperture explores one third of each image. Behind these apertures are three photoelectric cells, connected to the necessary amplifying equipment. Currents from the three amplifiers are then passed by telephone lines to the receiving station.

AT the receiving station the currents are received by three neon tubes, in the smaller type of receiver. These three neon tubes are of a special spotlight type, and the light from them is focused by means of a lens upon a revolving drum, similar to that at the transmitting station, the light being thus reflected upon a translucent screen. The moving spots of light then reproduce the image in three zones. It is exactly as if three television pictures were transmitted by three television transmitters to three television receivers, the three images being placed one next to the other, to form a continuous picture.

The advantage of zone television is that there is no restriction whatsoever as to the detail. Given a sufficient number of zones the detail can be made as great as desired—only, of course, at the expense of further complexity.

In addition to the Baird three-zone apparatus described above, a further advance has been made. This has been called by Mr. Baird the "television arc." Hitherto only two sources of modulated light have been known and used for television—the neon tube, or similar glow discharge tube, and the Kerr cell. Of these the neon tube has definite limitations as to its brilliance, while the Kerr cell, although more brilliant than the neon tube, is an extremely inefficient device. In the Kerr cell, the light from an arc lamp passes through two Nicol prisms, between which is placed a small glass tank containing nitro benzine, in which are immersed two electrodes; the light passes through the narrow space between the electrodes, which are connected to the incoming television signals, and the fluctuations in electrical potential alter the degree of polarisation of the light, and thus regulate the amount of light passing through the device. This entails, however, a very considerable loss of light. The total loss has been estimated at as much as 75 to 80 percent of the light entering the prism. If, now, the light of the arc itself could be modulated, this loss would be obviated, and this is exactly what Baird has succeeded in doing.

Many years ago it was discovered that, if the electrical impulses from a telephone were superimposed upon an arc, the arc would follow the speech modulations and actually reproduce the speech. This phenomenon was well known as the "speaking arc"; but whether the arc could be made to follow the extremely rapid fluctuations of television was another matter and, considering the extreme rapidity of these fluctuations it appeared on the face of it an impossibility. This impossibility has, however, been achieved, and the television arc is an accomplished fact. In a recent demonstration the television signals were superimposed upon a special arc, which replaced the neon tubes, with the result that images obtained were of amazing brilliance. The images were equal in quality to those produced by the neon tube, and incomparably more brilliant.

TIDYING UP THE CONSTELLATIONS

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

FOR so rapidly growing and active a science, astronomy is in some respects curiously conservative. Along with the vast accumulations of modern data, it possesses and still keeps in daily use features which originated back in ancient times. For example the curious system of stellar magnitudes, according to which we represent the faintest stars by the largest numbers, seems grotesque to the student who first encounters it and he is likely to ask why astronomers adopted such a queer backhanded arrangement. The reason is of course that this system goes back to the ancient star catalog of Hipparchus. When accurate measures of the stars' brightness began to be made in the 19th Century the nomenclature by which astronomers were accustomed to describe them was more than 2000 years old. But older terms than this are still in daily astronomical use—so much older, indeed, that no one knows just how old they are.

FROM the remotest antiquity men have noticed that the stars were set in permanent array in the heavens and many of the more conspicuous groups were not merely recognized but named. No one knows when this began to happen—it may have been before recorded history began—but there can be little doubt *where* it happened. The oldest of the constellations bear the names of animals, wild and domesticated—the Ram, the Bull, the greater and lesser Dogs, the Lion, the Bears, the Wolf, the Eagle, the Swan, the Serpent, the Scorpion. Now these are the creatures native to the Near East—the animals of the Bible—and the assemblage points conclusively to a Mesopotamian origin. They can not be Egyptian for there is no hippopotamus and no crocodile; nor Indian—for the tiger and the elephant are absent. The Chinese have to this day an entirely independent system, dividing the stars into quite different groups.

Not all of the greater constellations are of this immemorial antiquity. Another important series bears names taken from Greek mythology—Hercules, Perseus, Orion, Cassiopeia—which again tell their own tale, though these names may have displaced those of more ancient worthies now forgotten.

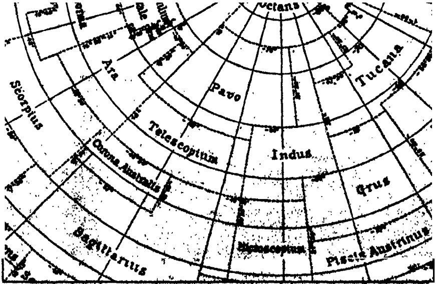
Toward the latter part of the classic times when Ptolemy wrote his famous astronomical treatise, 48 constellations had become established in general usage. These include all the conspicuous star groups which are visible from northern latitudes and some which are by no means prominent; such as Sagitta, Equuleus. How the few faint stars of the latter constellation were ever imagined to represent a "little horse" is a mystery, but the people who named most of the groups must have been blessed with a vivid imagination.

In a few cases some resemblance can be traced between the star group and the figure whose name it bears—the curving tail of the Scorpion, the outstretched wings of the Swan, the circlet of the Northern Crown, and the long lines of the various snakes and dragons—though no terrestrial bears ever had tails as long as those which Ursa Major and Ursa Minor trail across the heavens. Usually, however, the relation is quite arbitrary, yet nevertheless it became stereotyped by convention; so that one could speak of "the star at the end of the bull's right horn" or "in the left knee of Orion" and be fully understood.

This was a clumsy way of identifying the individual stars and so the brightest of them came to have names of their own. Some of these still survive. Many of them are Greek—Sirius, Procyon, Arcturus; a few are Latin—Regulus, Spica; and others Arabic—Aldebaran, Altair, Rigel.

Neither of these methods was applicable when it came to a serious nomenclature applicable to all the stars easily visible to the naked eye. The method which is now in use dates from 1603 when Bayer conceived the idea of designating the stars of each constellation by the letters of the Greek alphabet—*alpha*, *beta* and so on—followed by the constellation name. Usually but not always he assigned them in the order of brightness; thus *Gamma Geminorum* is the third brightest star in Gemini. In a few constellations—such as Ursa Major—the letters run, in part, in order of the position of the stars. This scheme takes care of 24 stars in each constellation and does very well for the smaller ones. In the larger groups the Greek alphabet runs out and Roman letters were sometimes used for the fainter stars; but this notation is on the way to being dropped by general consent.

ALMOST all the naked eye stars fit into a scheme proposed by Flamsteed early in the 18th Century, in which the stars of each constellation (above a certain limit of brightness) are numbered in order of their right ascension. Thus the star 61 Cygni, though too faint to merit a Greek letter,



A typical section of the (southern) sky, with the formerly meandering borders of the constellations squared up ship-shape and tidy. From the "Atlas Coeli" is generally known by its Flamsteed number. As a system for labelling the brighter stars this double scheme has proved practical and convenient. The fact that it demands the acquisition of knowledge of the Greek alphabet and of a few Latin forms (the genitive cases of the constellation names) is hardly to be regarded as a loss from the standpoint of general culture.

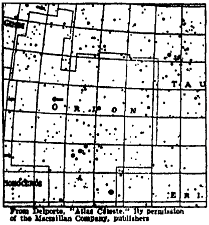
Before this plan was invented it made little or no difference if some of the less conspicuous stars were left outside the constellations. But when the attempt was made to find "a place for everything" it appeared that there were here and there in the skies bits of no-man's-land and new constellations were devised to fill up the gaps. In the northern heavens these naturally occupy dull and almost barren regions, but near the south celestial pole, among the stars unknown to the ancients, some of the new constellations are conspicuous. Only one, however, has made its way into general knowledge and even into poetry—the Southern Cross.

THE half dozen modern constellations in the northern sky have been named in classical fashion—the Giraffe, the Lynx, the Hunting Dog, the Lizard, the Fox. In the southern sky a more modern imagination found its play and a telescope, a sextant, a clock, a microscope, a mariner's compass (Pyxis), an air pump (Antlia), and other tools of science, appear along with the more conventional figures of a dove, a dolphin, a flying fish, a crane, a fly, and the like. Only one of the Ptolemic groups has been modified. The ship Argo occupied such a huge extent of the southern heavens as to be quite inconvenient and it has been divided into three constellations—Puppis (the mast), Vela (the sails) and Carina (the keel). Including these separately, the list of constellations now recognized totals 88.

If the system of naming stars by constellations was limited to those bright enough to be seen with the unaided eye the question could be considered as closed. For the fainter stars, in general, the accepted method is to give the number under which the star appears in some standard catalog; thus, Lalande 21185 is the star bearing this number in Lalande's catalog. (This happens to be one of the nearest in the heavens). This is a rather imperfect scheme, for a star may have as many aliases as a modern racketeer and special codes are used for objects of distinctive interest. Double stars, for example, are known by a letter representing the name of their discoverer, followed by a catalog number. Thus β648 represents one of the late Professor Burnham's discoveries.

For variable stars the constellation names are used, preceded by capital letters—R Arietis, S Cancri. As the list of discoveries grew, Z had to be followed by RR, RS . . . RZ; then SS . . . SZ, and so on to ZZ, after which a fresh start was made with AA, leaving enough room for the present, though in time we may have to come to three letters.

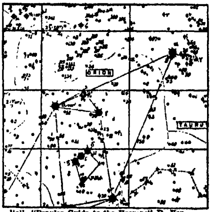
Now there are thousands of variable stars scattered all over the celestial sphere. When a discovery has been published and duly confirmed by further observations, an international committee under the auspices of the *Astronomische Gesellschaft* gives it a permanent designation. This committee must evidently have some established rule by which it may tell in what constellation the new variable belongs; that is, it must have a map upon which the boundaries of all the constellations are exactly delineated. This delineation of the constellations has been entrusted to a Committee of the Astronomical International Union which, working in friendly co-operation with the *Gesellschaft*, completed its work last year and published a star atlas giving the definitive boundaries.



From Delporte, "Atlas Céleste." By permission of the Macmillan Company, publishers

It proved possible to draw limits such as to include all the variable stars which had been assigned to each constellation previous to the middle of 1929 (at which time the committee began to use the new unpublished scheme). The adopted boundaries always follow either hour circles or parallels of declination; that is, they run either north and south or east and west in the heavens. The practical advantage of this is clear. If the boundaries ran slanting, or still worse if they were curved, a laborious calculation would be required to determine whether some newly discovered variable close to the line fell on one side or the other. As things are, a mere inspection of the right ascension and declination settles the matter. To remove all uncertainty the meridians and parallels are adopted relative to the position of the celestial pole and equator in 1875.

The atlas itself, which is published by the Cambridge University Press in England and the Macmillan Company in New York, shows all the stars to the sixth magnitude in 26 maps covering the whole heavens and is a valuable addition to any astronomical library.



Hall, "Popular Guide to the Heavens" D. Van Nostrand Company

A contrast. Constellation of Orion with *irregular* boundaries and, at left, the same constellation after its boundaries were tidied up by the International Astronomical Union

Lists of all the stars brighter than magnitude 4.5 opposite each chart provide the data for the identification of the more conspict

THE ancient mythological figures of the constellations are of course missing, since the atlas is for scientific use. These outlines, drawn after medieval originals, may still be found on celestial globes. A few years ago such globes, which are among the most useful accessories in teaching astronomy, were almost "out of print" (if the phrase may be used) and hard to get, but fortunately an excellent model of moderate dimensions has just been put out by the Rand McNally Co. The novice must remember that he is looking at the globe from the outside, while the stars are placed on it as they would be seen through its surface by an observer at the center. The star groups on the globe are therefore all reversed left for right in comparison with the actual appearance of the sky or of an ordinary star map, and a certain mental effort is required in identifying the actual constellations. A very amusing instance of this was once to be seen in a great metropolitan railway station in New York. The huge vaulted roof of the great hall was decorated—with excellent artistic effect—in gold on a blue ground, with the mythological figures of Orion, Taurus, Aries, and the rest, points of light shining through for the brighter stars. Unfortunately the artist had copied his figures from a celestial globe in innocence of the geometrical trap which yawned before him, so that the effect of the admirable decoration upon the astronomer was decidedly mixed!—*Princeton University Observatory.*

PROBLEMS OF CALENDAR IMPROVEMENT

By GEORGE EASTMAN

OUR present method of marking the progression of the days, weeks, and months is referred to as *the* calendar. As a matter of fact, it would be more apt to describe it, in the words of one irritated student of this subject, as "them calendars," because, instead of one calendar, we really have fourteen. Every one knows that the calendar changes, but few people realize that there are seven different patterns of it for ordinary years and seven for leap years, and that it takes 28 years to complete the cycle of the changes.

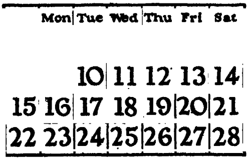
Probably few people realize, too, that these 14 patterns are caused by the fact that our seven day week will not fit in the solar year an exact number of times, there being one week-day left over in ordinary years and two week-days in leap years. The consequence is that January first of each year changes to a different day of the week, and so does every other date. Furthermore, because the months are composed of differing numbers of days, and because none of them except February will contain a whole number of weeks, not even the dates of the months in the same year can fall on corresponding week days. There are no less than 28 varieties of months in the 14 kinds of years. It is quite easy to construct a calendar of a single pattern, and not difficult to establish it.

AS long ago as 1745, a man by the name of Urban, living in Maryland, published in the *Gentleman's Magazine* of London, a proposal to establish a fixed, perpetual calendar with uniform months. He put forward a plan to have 13 uniform months of four weeks each, and to give the left over week-days an individuality of their own, so that all week-days, Sundays, and holidays would stay fixed to unchanging dates.

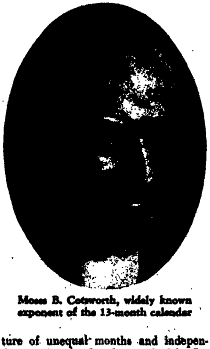
"How confusedly," wrote this colonial American in the odd script of the 18th Century, "is the year divided into 12 kalendar months, some consisting of 30, some of 31 and February of 28, and sometimes 29 days!

"How preposterously do the days of the week vary in different months of the same year, and again in the same months of different years!"

In 1751, six years later, the British Parliament did, indeed, enact a law for the improvement of the "kalendar," but, unfortunately for posterity, ignored the suggestions of the man in Maryland. The British lawmakers went no further than to adjust the Julian calendar then in use in the British dominions to the Gregorian reckoning, dropping 11 dates from the year 1752 and changing the beginning of the year from March 25 to January 1. The hodge-podge structure of unequal months and independent weeks, the first bequeathed by Julius Caesar and the other jointly derived from pagan astrology and Hebrew religious custom, as historians tell us, was left as it was and as it still is.



Every month of every year would be alike. No more of "Thirty days hath September. . ."



Moses B. Cotsworth, widely known exponent of the 13-month calendar

Without doubt the reason that the proposals of Urban failed to receive consideration was that, while they were logical and scientific, they did not seem in that day of much practical importance. When Urban posted his essay from Baltimore to London, it may have been two months enroute. The steam engine had not even been invented and the steam vessel still belonged to a century of the future. Economic life was simple. International intercourse was on a small scale. Agriculture was the dominant occupation. Individual life was less ordered and less dependent upon calendar appointments. The calendar's chief utility was that it accurately marked the seasons for the benefit of the farmer, showing the fixed dates for the equinoxes and solstices. As units of time, the month and week were far less important than the seasons or, roughly, quarters of the calendar year. The complex and swift-moving "Scientific Age," "Industrial" or "Machine Age," as we variously call our present times, had not arrived. Urban, who seems to have been the first man to propose the adoption of a fixed, uniform calendar of 13 months was far in advance of his day.

NOW, under the pressure of vastly changed conditions, intimately affecting every individual, the month and the week have become the paramount units of the calendar. The commercial and industrial agencies of our new civilization require much shorter periods than the seasons to measure their progress and control their activities, as do the scientific agencies for analyzing data. Perforce, they must use the month and week, because these are the only short units which the calendar provides. This being so, the fact that the months are not symmetrical and the weeks can neither symmetrically nor permanently be fitted into them, calls loudly for the reform of the one and the adjustment of the other.

Such is the purpose of the international movement to improve the calendar, which took shape about ten years ago, and will culminate in the International Conference to be held at Geneva next October under the auspices of the League of Nations. Various plans will be considered at this Conference, but in my personal judgment, none is superior to the plan for 13 months of four weeks, each month with week-days fixed to perpetual dates. Others since Urban's day have proposed this plan with the details worked out in different ways. In the present century, Moses B.

Cotsworth has undoubtedly done more than any other man to bring its advantages to public attention. Mr. Cotsworth has worked out the details in admirable fashion, with careful regard for usages of the calendar already fixed by science, and with as much respect for tradition and established terminology as is consistent with the essential changes. In substance the plan is this:

Those months which now have 30 or 31 days would be shortened to 28 days each, like February. The days thus removed, except one (two in leap years), would be combined into another month of 28 days called "Sol" and placed in the middle of the year between June and July. With "Sol" in this central position rather than at the end of the year, the other months would hold their places in the seasons. Thus with each month the same length as another, and each containing exactly four weeks, the problem of uniformity is simply solved.

THE problem of fixing the week-days to the same dates each year is likewise easy. It is logical and desirable that the first day of the year should always coincide with the first day of the month and with the first day of the week; that is, that January 1 should always be Sunday. To accomplish this all that is necessary is to give a separate name to the extra week-day beyond 52 weeks that occurs in every year at present, and a separate name also to the additional extra week-day in leap years. Mr. Cotsworth has suggested "Year Day" and "Leap Day" as appropriate n this way the one or two days t needed for "Sol" would be taken up.

It is easy to see that then, not only would every year always begin on Sunday, but each of the 4-week months would always begin on Sunday, and every week-day would fall on the same four recurring dates in every month. Saturdays, for example, would always be the 7th, 14th, 21st and 28th. Month ends would coincide with week ends.

Since "Year Day" and "Leap Day" would need dates as much as the other days, he gives the one the date December 29, the other the date June 29, and proposes that both be holidays. Thus, calendrically, each would have a place in a month. "Year Day" would at the same time become the 8th day of the last week in December, and "Leap Day" the 8th day of the last week in June every four years.

The placing of all the present holidays on a Monday, as is done at present with certain holidays in Australia, and the fixing of Easter, if the churches agree, complete the details of the plan.

The manifold benefits which would be conferred by a calendar of fixed week-days and uniform months in all our affairs, public and private, have been frequently described and need not be repeated here. Various other calendar plans now being urged remedy some defects of the present calendar in one way or another, but it can be shown that there is none other than the 13 months fixed calendar that can remedy all the defects and at the same time meet *all* the four following requirements of an ideal universal calendar for our civilization:

1. *Continue to keep the calendar in step with the solar year;*
2. *Keep the 7-day week as a time unit;*
3. *Fix the week-days to perpetual dates;*
4. *Establish uniform months commensurate with the weeks.*

From the point of view of these requirements, some of the other proposals are interesting to examine. The plan known as the 12 month equal-quarters fixed calendar has gained favor among those who feel that introducing a new month would be too much of a departure from tradition to be acceptable. Under this plan each quarter would consist of months of 31, 30 and 30 days, or in reverse order. Also, as in the 13 month plan, a "Year Day" and "Leap Day" would take up the extra week-days. This kind of calendar does Numbers 1, 2, and 3, but not 4. Only the quarters of the year are commensurate with the week, each having thirteen. Its months all contain fractions of weeks and are not themselves uniform, as in the present calendar. It does not do the whole job.

NOT a few schemes follow the principle of the calendar which we are told the Russians are using, dividing the year into 12 months of 30 days each and placing 5 or 6 holidays here and there to take up the slack. The months in these schemes are divided into 6 five-day weeks or 5 six-day weeks. This principle does numbers 1, 3, and 4, but fails at 2. It is surely too radical a departure from our hebdomadal rest-day system to stand a chance of acceptance with most of us.

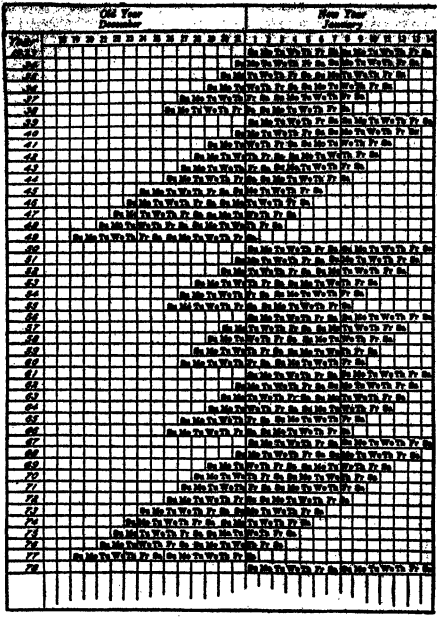
MONTH	1st WEEK	2nd WEEK	3rd WEEK	4th WEEK	5th WEEK	6th WEEK	MONTH
	S M T W T F S	S M T W T F S	S M T W T F S	S M T W T F S	S M T W T F S	S M	
Jan	1 2 3	4 5 6 7 8 9 10	11 12 13 14 15 16 17	18 19 20 21 22 23 24	25 26 27 28 29 30 31		Jan
Feb	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28			Feb
Mar	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	29 30 31		Mar
Apr	1 2 3 4	5 6 7 8 9 10 11	12 13 14 15 16 17 18	19 20 21 22 23 24 25	26 27 28 29 30		Apr
May	1 2	3 4 5 6 7 8 9	10 11 12 13 14 15 16	17 18 19 20 21 22 23	24 25 26 27 28 29 30	31	May
Jun	1 2 3 4 5 6	7 8 9 10 11 12 13	14 15 16 17 18 19 20	21 22 23 24 25 26 27	28 29 30		Jun
July	1 2 3 4	5 6 7 8 9 10 11	12 13 14 15 16 17 18	19 20 21 22 23 24 25	26 27 28 29 30 31		July
Aug	1	2 3 4 5 6 7 8	9 10 11 12 13 14 15	16 17 18 19 20 21 22	23 24 25 26 27 28 29	30 31	Aug
Sep	1 2 3 4 5	6 7 8 9 10 11 12	13 14 15 16 17 18 19	20 21 22 23 24 25 26	27 28 29 30		Sep
Oct	1 2 3	4 5 6 7 8 9 10	11 12 13 14 15 16 17	18 19 20 21 22 23 24	25 26 27 28 29 30 31		Oct
Nov	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	29 30		Nov
Dec	1 2 3 4 5	6 7 8 9 10 11 12	13 14 15 16 17 18 19	20 21 22 23 24 25 26	27 28 29 30 31		Dec

What a contrast between the present calendar (shown above) and the fixed 13-month calendar below; the one a hodge-podge, the other orderly, uniform, and systematic

MONTH	1st WEEK	2nd WEEK	3rd WEEK	4th WEEK	NO SPLIT WEEKS
	S M T W T F S	S M T W T F S	S M T W T F S	S M T W T F S	
Jan	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	
Feb	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	
Mar	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	
Apr	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	
May	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	
Jun	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	29 "LEAP DAY" EVERY FOUR YEARS
Sol	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	
July	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	
Aug	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	
Sep	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	
Oct	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	
Nov	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	
Dec	1 2 3 4 5 6 7	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	29 "YEAR-DAY"

Another scheme quite eloquently advocated rejects the "Year Day" and "Leap Day" principle, and sets up arbitrary calendar years containing an exact number of weeks. It would begin with a short year of 364 days, or exactly 52 weeks. The calendar year would then divide into 13 four-week months without remainder. The one or two extra days necessary to complete the solar year would be set aside in the first and following years until they amount to a week and then put back into the calendar as a 53rd or "leap week" every 5 or 6 years.

Superficially this seems to be an elegant solution of the problem of uniformity for a 13-month calendar, with the leap week coming only occasionally. It has been particularly urged by cer-


Old Year
December
New Year
January
Year
18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Su Mo Tu We Th Fr Sa

How the weeks of the present calendar drift, day names changing to different dates each year. A sample taken out of our present calendar at the New Year

tain religionists who object to the "Year Day" principle because it interrupts the perfect sequence of their Sabbath. But so many practical objections have been raised to this solution from scientific, economic, social and religious points of view, that one can imagine most people preferring the present calendar as less objectionable. Obviously it does not meet requirement Number 1, and in failing to do so, it is declared with reason that to adopt such a scheme would be a retrograde step in the long evolution of the calendar to its present state of perfection as a measure of the solar or tropical year.

Certainly a calendar of long and short years would be impracticable for scientific and astronomical purposes. The length of the tropical year is now 365.24219879 days according to Newcomb's equation. The Gregorian leap [illegible], which omits three leap years in 400 years, so adjusted the calendar that it marches very closely in step with this equation, and it will continue to do so for quite a long time. It is possible to adjust it still more closely by a more accurate rule, but the vernal equinox, the pivot of any solar calendar, is kept by the Gregorian rule fairly constant to noon March 21, the 80th day in the calendar year. The proposers of the leap-week scheme seem not to apprehend that, by omitting from the calendar one or two days each year and then putting back seven of them every 5 or 6 years, the date of the vernal equinox would be dislocated and oscillate from year to year to different dates. Worse than this, if this calendar is always to begin on Sunday, it will be necessary, at certain intervals, to accumulate the extra week-days for as much as 11 years and then insert two weeks. This would cause an extreme oscillation of the vernal equinox from the 80th to the 94th day of the calendar year. Such fluctuations of this and the other tropical dates would, for one thing, throw the Nautical Almanacs into confusion and perhaps, I am told, lead to marine disasters.

Some years in such a calendar would be 364 days in length, some 371 and some 378. Such long and short years would seriously confuse the Julian day count used by astronomers. Such years are not comparable for economic and scientific data. No one would know his age with precision. It would confuse the calculation of actuarial tables, pension plans, annuities and the like, make difficult the fixing of anniversaries and dislocate the liturgies of churches.

SOME who are opposed to a fixed calendar advocate the adoption of the foregoing leap-week scheme for business uses only, leaving the present calendar as it is. As a means of obtaining the advantages of fixity, as they conceive them, they have devised a system for numbering the weeks by the number of their Sunday in the year and designating dates by them. Such a week-numbering and week-dating system, it is claimed, would give the advantages of a fixed calendar because days in numbered weeks would have a permanent relation from year to year, and what are defined as "permanent schedules" of business and community events could be satisfactorily arranged. They suggest that this system, extensively used by business, would come to be used by the public. An example given is "F-51-1931," or Friday of Week 51, as the date of Christmas this year. A fair held from Monday, August 10 to Saturday, August 15, 1931 would be dated as Monday to Saturday of Week 32. Such events, it is suggested, could always be held according to a numbered week.

The advocates of this scheme probably are not aware that similar dating schemes have already been tried by business concerns now operating on the 4-week period system, and given up as impracticable. Experience has shown that confusion and mistakes occur when dates such as 4-6 (4th period, 6th day) also have to be referred to by the dates of the regular calendar, as is often necessary in actual practice. Further, no solution is offered for the difficulty of holidays and other anniversary dates changing to a different week-day each year and drifting from one numbered week into another and in some cases, from one 4-week period into another. The latter inescapable difficulty is one of the disadvantages of using the 13 four-week period system in business at present.

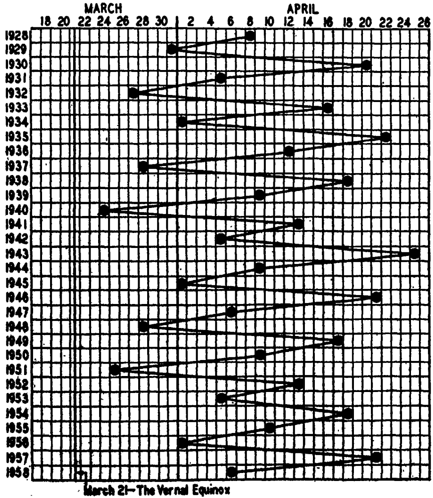
As to the week-dating system from the point of view of the public, it is not difficult to show by calendar tables that if *every* week of the weekly cycle is to be counted and numbered according to its Sunday, one week or another that follows a Week 52 and is partly in one year and partly in another, must be omitted from the count, else the following year will have a Week 53. Presumably the proponents do not intend to have us omit a week from the count, but on the other hand if one is not at some time omitted, the end of Week 52 will always drift back to December ing a complete week at the end ear. A Week 53 is inescapable. week Christmas will fall. In vords, Christmas can not regu- fall in the same numbered week year (Week 52) without leaving one week of the cycle unnumbered from time to time.

Again, if the scheme does omit a week, as is perhaps inadvertently the way the proponents arrive at their illustration "F-51-1931," it is easy to show that Christmas can not regularly fall in Week 51, but sometimes in Week 52. Likewise, it is easy to show that Week 32 as the date of the August fair will in some years become Week 33 unless the number of one week is from time to time omitted from the cycle. In either case, arranging schedules of fairs and the like by numbered weeks compels them to fall on a different set of calendar dates each year. It is difficult to see just where the character of permanency resides in this scheme.

Indeed, it seems fantastic to suppose that the public would welcome any sort of week-dating system as a convenience. Without referring to a complicated, annually-changing, printed calendar on which the weeks are numbered and graphically distinguished from the months which they overlap, who of us could easily remember in what part of the year or in what month the 39th week would fall, for example, to say nothing of having to keep account of the irregularly recurring Week 53? The whole scheme obviously not only fails to meet requirements No. 1 and No. 3, but as a device for remedying the defects of the present calendar is "confusion worse confounded."

Still other schemes, without altering the length of the year, provide for greater uniformity of months or quarters as far as possible, without taking up the extra week-days with special names. These fail, of course, to meet requirement No. 3. We should still have 14 different calendar patterns.

The delegates to the Geneva calendar conference will doubtless thresh out the advantages and disadvantages of all these proposals and make a decision. The program is for them to consider calendar simplification from the economic and social viewpoint, and draw up a treaty for the ratification of Governments with an agreed date for putting the improved calendar into effect. The Conference, of course, will take into consideration the views that may be expressed by interested religious bodies in so far as any change may affect their creeds, dogmas, or traditions. For putting a new calendar into effect legislation to legalize the changed dates is all that is necessary. The inconvenience of adjustment would quickly disappear.



The present date of Easter is governed by the first full moon after the vernal equinox, and drifts 35 days between March 22 and April 25, as indicated

DR. CHARLES F. MARVIN, Chief of the United States Weather Bureau, and, I believe, our foremost American authority on the calendar, has suggested a time and way for putting a fixed calendar into effect which is of most interesting significance to Christianity. It happened that the Gregorian reckoning adopted in 1582 A.D. corrected the Julian reckoning only as far back as the year 325 A.D., the year of the Council of Nicaea, when the rule for fixing Easter was established. Pope Gregory made this much needed correction by dropping 10 dates from the Julian calendar, so as to restore the vernal equinox to March 21, its date in 325 A.D., and re-establish correct dates for the Easter festival. If, however, he had dropped out two more dates, he would have corrected the Julian reckoning back to the year 1 A.D.

Dr. Marvin suggests that these two dates could now be dropped in connection with the adoption of a new calendar, thus making our chronology exact from the beginning of the Christian Era. If the dates December 30 and December 31 of 1935 were omitted, and the first "Year Day" inserted as December 29, then January 1, 1936 would be Sunday. If this were done, it is of remarkable interest that every year in a fixed calendar started in 1936 would be an exact counterpart of the year 30 A.D., the last year of the life of Christ. The Crucifixion occurred in that year on the 97th day which was a Friday and the Resurrection on the 99th day which was a Sunday. If the new fixed calendar were started in the above manner, these two days would always be Friday and Sunday respectively, always the exact anniversaries in day name and number in the year of these two fundamental events in the history of Christianity. Instead of the present wandering date for Easter, the festival could always be celebrated on this true anniversary Sunday. If the churches agree, it would be simple under a fixed calendar to fix a permanent date for Easter.

TONS OF HUMAN HAIR IN INDUSTRY

By GRACE LOCKHART

IN the city of Augusta, Georgia, famed for fair skies, magnificent pines, and superlative winter golf, is a unique, little known, and interesting industry conducted by the Southern Press Cloth Manufacturing Company. The finished product is a coarse, tough fabric known as "oil press cloth," woven of Chinese hair. The cloth is used for the extraction of oils from vegetable seeds—cotton-seed, flaxseed, linseed, copra, the cohune nut, and the sunflower seed—and, in some forms, in pressing vinegar, syrups of various kinds, malt liquors, cocoa-butter, glucose, and similar industrially pressed products, where a medium is required that permits free drainage and is able to withstand great pressure and extreme changes in temperature.

THERE are only four plants in the country engaged in the manufacture of press cloth, and of the 3,000,000 pounds of Asiatic hair imported annually for press-cloth purposes, the Augusta plant uses a large proportion. Its busy looms last year turned out 133 lineal miles of this strange fabric, sufficient to carpet the fairways of both championship golf courses at the Augusta Country Club.

Based on the Bradford draft system of wool spinning and weaving, press cloth is made in this country in Georgia, Texas, Louisiana, and South Carolina. Abroad, important plants are located chiefly in France and Germany. Augusta is the second largest inland cotton market in the world, receiving 1000 bales every day including Sundays, and the press cloth factory, established in the year 1916 near the Carolina piedmont section, is a highly important link in the economic chain of cotton-seed oil mills. Of these there are some 600, five of which are located in Augusta. The oils and their derivatives are used for many purposes such as salad oils, shortening, butter substitutes, soap stocks, paint bases, and medicinal compounds.

Formerly the individual landowner, needing essential oils, crushed his oil-bearing seeds in hand presses. For production in commercial quantities, the hand press was, of course, wholly inadequate. Gradually was developed the present powerful hydraulic press. To meet the requirements of the hydraulic press, "oil press cloth" was designed and perfected. Thereby was opened up an important new market for Chinese hair, discovered to be the most satisfactory fiber for withstanding the terrific heat and pressure to which the cloth is subjected.

Upper left: A piece of press cloth and a hank of Chinese hair from which this material is woven. *Above:* Sorting a shipment of hair at a press-cloth fac

An eight-press mill, operating on standard schedule, can put through 25,000 tons of cotton seed in a seven- to eight-month season. Out of this quantity are produced 7,500,000 pounds of crude oil—about 300 pounds of crude oil to every ton of seed.

The cotton-seed meats are first run through a crusher where the oil cells are literally "unlocked." The mass is then heated in steam sectional cookers to about 180 degrees Fahrenheit, whence it emerges through a mechanically operated gate into what is known as a press former. Here, wrapped in press cloth, and placed on a steel pan, it is charged into the press. When the press, which consists of about 15 boxes separated by steel plates slotted for drainage, is completely charged, hydraulic pressure is applied at from 3500 to 5000 pounds per square inch. It requires from 20 to 30 minutes for the press column with its slotted plates and charge of meats to move up and back down again.

Although apparently level in the boxes when the press is charged, the meats, when pressure is applied, begin to seek a true level. This stretch-out is known as the "crawl of the meats," and the pressure in every direction subjects the cloth to terrific strain. The increasing temperature of the meats to about 240 degrees, Fahrenheit, during the process, through reduction in volume and increase in density, adds heat to strain. The ammonia content, high degree of moisture in the seed, and free fatty acid in the oil tends further toward the destruction of the cloth. The average life of press cloth under ordinary cotton-seed oil milling conditions is 7 to 15 days. Under linseed-oil milling conditions, the cloth lasts considerably longer. Usually it burns out before it disintegrates or wears out.

Thus it may be seen that no ordinary fiber can be used for the manufacture of press cloth. In the early days of press-cloth manufacture, Russian camel's hair was considered the peer of fibers. Press cloth, first manufactured in this country toward the end of the 19th Century, was made almost entirely of this material. During the World War, however, camels were used as beasts of burden in the Russian armies for transportation of munitions and supplies, and were rapidly slaughtered in battle. As a result of the extinction of the Russian herds, it became practically impossible to obtain camel's hair for commercial use.

As usual, necessity was the mother of invention. The industry looked around for substitutes. Chinese camel's hair was tried first. But the herds were relatively small and the quality of the hair not as suitable. At one time or another various fibers had been tried and found wanting—cotton, horsehair, cattle tails, wool, mohair, and llama hair. These had proved either too costly, or too easily destructible. Finally press-cloth analysts experimented with Chinese human hair. Perfect!

Of the several types of human hair used for commercial purposes—Italian, Czechoslovakian, German, and Asiatic—oriental hair is markedly superior for press-cloth purposes. Grown on the heads of people born to manual labor and outdoor life, it has more resiliency, greater tensile strength, is larger in diameter, and has more oil cells to the strand than average human hair. Likewise it has none of the brittle tendencies common to horsehair, cattle tails, or hog bristles.

Cultivation of hair, therefore, is an important business to China's millions. The general opinion that queues furnish the bulk of the shipments is incorrect. In 1910 Manchu orders against this sign of bondage occasioned millions of queues to be lopped off which, incidentally, were cashed in by the millions for a bowl or two of rice. Since that time women have almost entirely monopolized the sale of human hair. Eight- to fourteen-inch hair is the desirable length for press-cloth use, the average feminine Chinese head producing 10 or 12 ounces of hair a year.

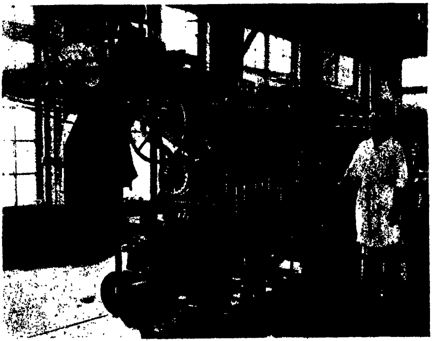
The hair is gathered in China's sleepy interior, and from her far outposts by oriental dealers who have built up their business through the years. They are more or less vague about the hundreds of thousands of families from whom they obtain hair of the required length and consistency.

So-called "sidewalk barber shops" are common in China, a "seat on the curb" as it were, where the barber cuts his customer's hair for the value of the hair. Then there is the itinerant barber who goes to his customer, and who cuts tresses for their market value.

So in various and devious ways and means the hair is gathered. Thence it passes through the hands of countless middlemen, is sorted, graded and prepared for re-sale to the Chinese merchant. Next it is carted by mule or camel, floated on a flatboat, or freighted in junks to a central city or point of navigation.

Arriving at the factory the bales are unpacked and the bundles sorted, dusted, and cleaned. The hair is put through a scouring machine, washed in water, and dried. Then it is blown by compressed air through a pneumatic tube to the processing department where it is neatly combed with a giant comb having steel teeth, and "drawn"; that is, its length increased and its diameter decreased. It is now ready for spinning. By a reducing process the diameter of the spun hair is further decreased, and the strength increased by twisting into 2, 3, or 5 ply threads. Finally the separate strands are twisted together to form the finished yarn. Out of this yarn, press cloth is woven on massive looms in widths ranging from 11½ to 22 inches and in single or double thicknesses, with heavy center and light edge, w light center and heavy edge, in t or diagonal weave as is re- c d. The cloth is woven in con- t us lengths and wound in rolls con- t ng about 400 feet.

Chinese business greetings: See translation in column directly below



One of the machines used in the preparation of press cloth from Chinese hair. Here the cleaned and stretched hair is twisted into strands of 2, 3, or 5 plies

BECAUSE of the distance of the s supply—it is 15,000 miles from the farthermost point of supply to the Augusta mill—it is necessary to keep the hair crop moving smoothly through the channels of trade. A reasonable stock must be kept on hand, and in process of production and distribution. Commitments must be made far enough ahead to ensure a steady supply on hand at orderly spaced intervals without overstocking the shelves.

Gold paper scrolls, hand lettered in Chinese symbols, hang in the office of Mr. Fielding Wallace, president and owner of the Southern Press Cloth Manufacturing Company, presented to him at the conclusion of a year's business transactions between East and West. They say:

"Alert by activity you have achieved success and your ancient repute is rooted like an oak."

"May you forever gain wealth and vast estate, winning the trust of all."

THIS NEW BIG BUSINESS OF GARDENING

By ARCHER P. WHALLON

HE was a familiar and pathetic figure, as he sat with hunched back on the seat of his ramshackle wagon. His strident voice vied with creaking wheels, as the bony horse plodded its dejected way up and down the streets of the old home town, inviting thrifty housewives to penny-pinching dickering for potatoes, cabbages, beets, carrots, turnips.

Such was, and possibly even now is, the mental picture carried by most of us of the market gardener, a sorry old fellow, peasant-like and humble, willing to bend his back in interminable weed-pulling for a pittance, flattered by the condescending patronage of main-street magnates, the butt of small boys' pranks, and of his more fortunate neighbors' commiseration.

He still survives, but only as a curious and archaic figure. In the present-day production of vegetable crops, his place is inconsiderable. The one-time job of manual drudgery has grown up into a mechanized industry in which the poor, old, hoe-wielding gardener has scarcely a larger place than has the village blacksmith in the modern steel industry.

TURN now to modern scenes: greenhouse ranges that rival in size and value large manufacturing plants; a fleet of 124 large tractors run by a canner of sweet corn and peas; 400 acres under the overhead irrigation pipe lines of a New Jersey gardening corporation; 250 acres of onions in a block cared for by a fleet of 20 garden tractors; a grower of 175 acres of dandelions—truly, it seems, the modern vegetable grower is a big business man.

This transformation of individualized manual drudgery to a large scale mechanized industry, though it really began a quarter of a century ago, has had a most pronounced acceleration in the past five years. Several interlocking influences have contributed: the development of efficient methods in the transportation, preservation, and marketing of fruits and vegetables; a pronounced change in American diet and living conditions; the mechanization of agriculture; the conquest of intensive cultivation by mechanical and technical innovations—the modern greenhouse, sprinkler irrigation, the garden tractor and its allies—in a way that would once have been thought impossible; and the introduction of many new and improved vegetable crops.

Cultivating with a one-wheel garden tractor, the modern farm horse

To make better foods at lower prices: An overhead sprinkler irrigation system in use in the production of root crops

It seems almost incredible that New Yorkers are now devouring head lettuce and melons by the car load, grown in a region 3000 miles away that scarcely more than 50 years ago was marked on the maps as the "Great American Desert." There is also no small contrast between modern refrigeration and storage methods and that of the Frenchman, M. Rose Charmeux, who in 1852 invented a device for the display and conservation of fresh grapes—a rack fitted with rows of bottles of water, each holding its portion of fruit-bearing vine. Progress continues. To the refrigerator railroad car has been added the refrigerator motor truck. Dry Ice (solid carbon dioxide) and Silica Gel promise still further facility in the transportation of fresh produce from the grower's fields to the grocer's counters. But there is no pause here. Before me is an advertisement in a French horticultural publication offering airplane delivery of flowers and plants; in Germany, a considerable quantity of perishable fruit is now being shipped by air. In one case reported, 800 pounds of German strawberries, shipped from Berlin in the morning, arrived at Copenhagen, Denmark, in three hours. Thirty hours would have been required by rail.

IT is impossible to foretell what the effect of rapid air transportation of southern grown fruits and vegetables will be. It will undoubtedly influence the business of the northern grower, the greenhouse man, and the canner. But it is unreasonable to expect that these branches of the vegetable industry will not be able to survive this increased competition, for each has its own field of advantage. Closer territorial specialization may follow, the commercial production of different crops probably being more closely restricted to regions particularly well suited to their growth. Understand, also, that the advantage of the greenhouse man is not merely that he can grow crops "out of season," for the term "season" with regard to most vegetables is becoming obsolete, but that with his superior control of growing conditions, he can produce vegetables of a quality unapproachable by the outdoor grower in any climate.

Furthermore, the canner's business is not the mere preservation of fruits and vegetables, but the manufacture of them into a delectable and immediately available table product. He has even complied with the modern woman's predilection for "cooking with a can opener" by packing canned boiled potatoes, "so convenient for making a potato salad," and one need but inspect the shelves of a single first-class grocery to see how thoroughly the canning trade has searched the cooking lore and the kitchen art of the four corners of the globe.

Coincident and closely linked with this change in the production and distribution of fruits and vegetables, a marked change in the American diet has taken place. To this, better living conditions, better home heating, a decline in the necessity for hard manual labor, a better understanding of the nature of a balanced protective diet and of the value of vitamins, have all contributed. In most every trade the old, hard, heavy, energy-consuming, manual labor jobs are being eliminated, and the great mass of working people no longer have the ravenous appetites of woodchoppers and roustabouts. Carried about in automotive vehicles, we no longer have to feed heavily to compensate for the energy lost in walking; in well heated homes, we need not practice the meat gluttony of the Eskimo to keep

We are becoming increasingly epicurean, and whereas the old diet consisted primarily of bread, meat, potatoes, coffee, and sugar, we are now eating more fruits and vegetables. This change in diet is beginning to influence crop production; it shows in the low price of wheat and corn, and will tend to restrict staple crop production further.

A profitable crop of choice greenhouse cucumbers showing the stick and [illegible] head wire-mesh support. Notice the sprinkler irrigation pipe in operation

A large size, riding-type powerful garden tractor [illegible] used [illegible] advantage for pulling an efficient field crop spraying outfit

Another factor is the readjustment of agriculture caused by the rapid extension of the use of large automotive machines, particularly in the western grain and corn belts. This is gradually forcing small farmers out of grain and staple crop growing and into intensive cultivation of fruits and vegetables. The capital requirement for efficient grain growing is rapidly becoming by far too heavy for the small farmer. Let a man try to equip himself with the large modern machinery for corn and grain growing—tractor, corn picker, and combine—and he will soon find 10,000 dollars' worth of machinery on his hands. This is impossible to the large proportion of eastern farmers cultivating from 40 to 80 acres.

But if, to the small farmer, one door is being shut, another is being opened. The man who cannot afford a 4000-dollar tractor and combine harvester outfit, can use to advantage a 300-dollar garden tractor, and will often be able to produce a much more profitable crop if he abandons corn and grain growing entirely. This garden tractor, with the great variety of auxiliary equipment now available, enables one man to accomplish as much as could 10 men working with the old man-power gardening implements. It is now possible for the small farmer to cultivate the same acreage in fine garden crops that his father did in general farming.

A horse-drawn mulch paper layer. As the paper unrolls, plows throw soil on its edges to hold it

Other technical developments in vegetable production increase the efficiency of the worker and eliminate risk and loss. Peat pots, hotbeds, and greenhouses assure early starting and safe maturity of crops. Hotkap plant pro- ectors protect them from ost and insects. Automo- ve plant setters set such nall plants as celery, on- ns, and lettuce as close *four inches apart in the* w. These machines steer themselves across the field nd for precision and deli- *cy of touch rival the* *nplicated automatons of* *textile and printing* des.

Mulch paper ground, conserves soil mois- ents weed growth, d eliminates the larger share of cultivation. Overhead sprinkler irrigation systems assure *a crop regardless of drought, and give* frost protection. Tractor-mounted sprayers and dusters defeat insect and fungus foes over 20 or more acres a day. Revolving comb weeders pull weeds from the onion rows and do away with hand weeding. The electric tomato pollinator assures full crops both in the greenhouse and in the open air. Ethylene gas blanches celery and ripens and colors melons and tomatoes. Still the list is incomplete—vegetable washers, sorters and graders, bunch tyers, onion set planters, soil shredders, bulb planters, onion toppers, canning plants —these and more show how completely the work of the gardener has been mechanized.

WHERE the old time gardener was restricted to the old home town or to the tender mercies of city c mission merchants, his successor now markets his product by motor truck over a radius of a hundred miles, and if his produce fails of ready sale, his home canning plant converts it into a non-perishable product. The vegetable grower is no longer helpless in a buyer's market.

A "horse that doesn't eat its head off." A medium size garden tractor is used for heavy cultivation

Now this long array of gardening equipment is not really as formidable and forbidding to the beginner of small means as at first thought it might appear. The initial capital requirement is small in relation to the size of the opportunity and the possibility of quick returns. Most of the units are small and inexpensive, and it is not necessary for the beginner to have everything at once.

For the man who is willing to work rented land, and who is able to hire his plowing done, 200 dollars is enough to start business. This will more than buy a small garden tractor and all the necessary cultivating tools. Tractors of this type are usually fitted with 2½ horsepower motors and weigh around 200 pounds. They are too small and light to do much plowing, but are entirely practical for row crop cultivation, and fleets of a dozen or more of this size of tractors are used by many large growers.

If one raises crops drilled in the row, a seeder costing around 20 dollars is necessary, but if operations are at first restricted to hill-planted crops such as potatoes, sweet corn, melons, cucumbers, squash, tomatoes, peppers, egg plant, cabbage, cauliflower, and broccoli, even this is not required. All these and more can be taken care of with the small cultivating tractor, some kind of sprayer or duster, and some cheap, simple hand tools. A 10-acre crop is well within the capacity of such an outfit.

The equipment of the man who does his own plowing and heavy work and is entirely independent, is naturally, somewhat more expensive. He has the choice of three alternatives. He may invest in a medium or large size garden tractor outfit, or in the British-built once-over rotary soil tiller now being introduced in this country, or he may prefer to buy a used regular farm tractor to do the heavy work and a small garden tractor to do cultivating. In any case, the price of a very complete outfit will not be far from 500 dollars.

There is, of course, no plain line of demarcation between medium and large garden tractors, a progressive gradation in power and price being available. Those of three or four horsepower, costing from around 250 dollars, pull eight-inch and ten-inch plows in ordinary plowing. The larger, five to ten horsepower machines handle regular two-horse farm implements and ten-inch to twelve-inch plows in practically any soil. Most of these larger tractors are available in riding as well as walking designs, and the largest, a ten horsepower riding tractor, might better be termed a small farm tractor, as it is suitable for serving as the main power plant for 50-acre farms. These larger garden tractors render the grower independent of outside help, but plainly, the larger of them are somewhat heavy and awkward for cultivating small plants in narrow rows, such as, for example, muck-land onions.

The plain fact is that undertaking to plow with a single eight-inch or ten-inch plow is a time-killing proposition, impracticable except for small places. For many a grower the more efficient plan would be the purchase of a used two-plow farm tractor, only depending upon the small garden tractor for row cultivation.

The economic and social value of the garden tractor is no small matter. It will enable thousands of suburbanites and small land holders, to whom *the keeping of a single horse would* be impossible, to put their land under remunerative cultivation. Many families of this class, though their usual main income is from industrial employment, will be able in emergencies to maintain themselves from the products of their own land. The garden tractor is clean, it requires but little storage space, it does not demand daily care, nor does it "eat its head off while idle."

One more factor should not be overlooked. The gardener's field of opportunity is being enlarged, and the increasingly epicurean instincts of the public are being met, by the introduction and commercial cultivation of many valuable new crops unknown to our fathers. Escarole, the French globe artichoke, Chinese celery cabbage, the Italian vegetable marrow, casaba and Persian melons, Calabrese sprouting broccoli, Florence fennel, the cultivated dandelions, and Witloof chicory, now rival in market possibilities the familiar vegetables cultivated for a century.

All things considered, it is doubtful if there is open to the man with small capital another opportunity to get a start in business for himself with such a reasonable hope of ultimate independence, as this new big business of vegetable gardening presents.

Rear view of the automatic, self steering plant setter showing method of operation

The two men, riding backwards on the automatic plant setter, transplant such crops as celery, onions, lettuce, tomatoes, at proper intervals

FROM THE ARCHEOLOGIST'S NOTEBOOK

Bronze Bowl with Cow

THE collection of the late Theodore M. Davis, after years of litigation, has come into possession of the Metropolitan Museum and contains priceless treasures of Egyptian Art. In 1902 Mr. Davis obtained a concession to excavate in the Valley of the Tombs of the Kings at Thebes. One piece, a shallow bronze bowl (Figure 1) has a cow in the center, crowned with the horns and disk of the goddess Hat-Hor.

Figure 1

Home of a Notorious Roman

ANZIO is almost due south, 36 miles from Rome, on the Mediterranean Sea. It is the ancient Antium and has a long and interesting history. It became a fashionable summer resort of the Romans towards the end of the republic. Both of the bad emperors, Caligula and Nero, were born here. The latter, indeed, had a special affection for the town, and built an artificial port and a splendid villa in which he received the news of the burning of Rome. This villa is now being excavated and magnificent pavements and mosaics (Figure 2) of the Imperial Age have been uncovered. Our illustration shows one of the patterns and the remains of the walls. Nero's harbor was about 150 acres in area and was protected by a breakwater of which traces are still visible. Anzio is still a popular summer resort.

Figure 2

Lid of Canopic Jar

ONE of the masterpieces of the Davis collection is the lid (Figure 3) to a Canopic jar. Found in a tomb excavated by Mr. Davis in 1907, it is a portrait of the pharaoh Akh-En-Aten who attempted to substitute a monotheistic cult of the sun's disk for the old gods. The sculptor has softened the peculiarities of his subject, often exaggerated. The material is alabaster and the eyes and eyebrows are inlaid.

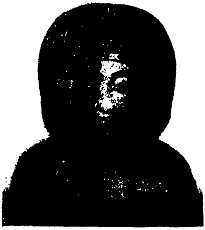


Figure 3

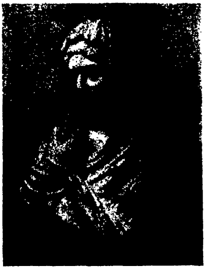


Figure 4

A Roman Portrait

A BEAUTIFUL Roman portrait bust (Figure 4) of the early 3rd Century A.D. has been acquired from the Baron Heyl collection. The height is 26 inches, the marble is white and fine grained and the flesh is differentiated from the coarser texture of the drapery by a light polish. An interesting attempt was made to imitate the mobility of the living eye by the use of two intersecting drill holes to mark the position of the pupil. The bust produces an air of femininity and gentle melancholy rare for the time.

Chinese Head-dress Ornament

CHINESE jewelry of the T'ang Dynasty (618-906 A.D.) is highly artistic, though bizarre, as is shown by one of the examples recently acquired by the Metropolitan Museum of Art. The Chinese rarely employ precious stones, with the exception of pearls as in the present case (Figure 5), where the phoenix (symbol of good fortune) has pearls set on the tail-feathers. The filigree work is of exquisite workmanship, comparable to fine chain mail.

MAN'S INSECT ALLIES*

By G. RAWSON, from Scientific Data supplied by G. LIGHTFOOT, a Member of the Australian Commonwealth Prickly Pear Board

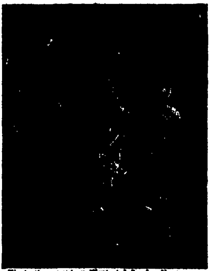
AUSTRALIA has been termed a land of pests, mostly imported from other countries. Not the least of these is the prickly pear, a plant of American origin belonging to the cactus family (*Cactaceæ*), a species which has spread over 50,000,000 acres of land in Queensland and New South Wales, and is known throughout Australia as the pest pear, or more simply, "the pear" (*Opuntia inermis*). A century and a half ago, when Australia was first colonized, the cochineal industry was a monopoly of Spain and Portugal; cochineal, of course, being a red dye obtained from an insect which lives exclusively on certain kinds of prickly pear. When the first fleet landed at Sydney in 1788, there were landed also specimens of the insect and pear privily obtained by the commander in Brazil on the voyage out, it being hoped to establish the cochineal industry at Botany Bay; but the plant and insects died, and for the time being Australia remained free from the pest.

FIFTY years later, a Dr. Carlisle, migrating in a sailing-ship to Australia from England, took with him, and carefully tended on the long voyage out, a rare plant in a pot. He settled at Scone, some 200 miles north of Sydney, and the doctor's gardener, enamored of the strange plant, carried it about and established it here and there, expecting it to be a good reserve food for stock in a dry year. Other plants found their way into Queensland farther north. They spread rapidly far and wide; the climatic and soil conditions suited the pear; soon it established itself everywhere, and about 1870 it was found that the pest had got beyond control.

From then on the pear rapidly spread throughout the sparsely inhabited hinterland of Queensland; it advanced in every direction; it grew with amazing rapidity; it was extraordinarily prolific; there was no stopping it; farmers and graziers were in despair. Forty years later—in 1910 —it was estimated that the pear had overrun 20,000,000 acres, and was advancing at the rate of 1,000,000 acres yearly. Over 30,000 square miles of territory had been invaded. By 1916 nearly 23,000,000 acres had succumbed to the pear, or 6,000,000 acres more than the total area under crops in the whole of Australia.

What is this terrible pear? It is a typical giant cactus armed with needle-shaped and powerful spines and bristles. These spines can penetrate a stout boot sole; the bristles are barbed, and, once they enter the skin or clothing, are not easily removed, and will cause serious irritation both to man and beast, and even illness. The flower is a large, yellow blossom, and the plum sized fruit is pear shaped—hence the name. The plant is drought resistant, and makes a dense growth of considerable height, constituting an impenetrable jungle of ve

Once the authorities had
aware of the enorm
plant and its devastating
steps were taken to deal with it
ernment Prickly Pear Traveling Commission was set up, which traveled round the world in 1912-14 studying the plant. An immense amount of information was obtained, particularly from the skilled botanists of the United States. Two solutions of the problem presented themselves. The pear could either be economically utilized, or it must be eradicated. Experiments were made to ascertain whether it had any marketable or useful qualities, but research failed to establish any means by which this immense area of plant growth could be economically exploited. Nothing remained but to attempt to eradicate the pest.



Illustrations courtesy *Illustrated London News*

A regiment of Cactoblastis tunneling out the interior of the cactus

56 million Cactoblastis eggs collected in Australia for distribution to ranchers who will turn them loose to work

ELABORATE machines were constructed for cutting, breaking down, rolling, and destroying the pear. Powerful tractors were brought up and attempts made to drive them through the jungle of growth. Teams of bullocks were harnessed to heavy logs by chains in such a way that the log worked at the side. But all these methods proved inadequate to the tremendous task of destroying the pear over 50,000,000 acres. Mechanical means and
and animal labor having been
doned, chemical poisoning was
tempted. Injection and sprayi
senic compounds proved effec
the method was found very costly
two pounds ten shillings to four p
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*Courtesy *Illustrated London News*

Wales were assisted by the Commonwealth Government; all the best scientific brains were enlisted; funds were provided for a new campaign, and a new method was decided upon—biological control. The Traveling Commission had found that in India and Ceylon the tree pear had, in many localities, been almost exterminated by a cochineal insect. Accordingly, segments of the tree pear with colonies of these insects were sent to Queensland from Ceylon, and also from South Africa. Tests were made, but alas! the insects could not even be induced to feed on any kind of prickly pear except the tree pear, and the pest pear had triumphed once again. What was to be done?

A striking case of "before and after taking:" at the right is a typical sample of Australian prickly pear infestation, and below is the result of three years' work on the part of the Cactoblastis caterpillar. It annihilates the host plant, even penetrating to the very roots

Enemies of plants fall into two classes—those which live on a great variety and are termed "omnivorous vegetarians," and those which live only on a single type of plant and are termed "restricted vegetarians." Obviously, a restricted vegetarian had to be found. But there were difficulties, and not the least was the fear of introducing some new pest worse than the pear pest itself.

Consequently, in seeking a "restricted vegetarian" which would prey upon the pest pear and on nothing else, the greatest caution was required. "Biological control" promised the only hope of success, but the insect itself must be completely under control; must do its work and then die! An experimental station was set up, and insects and parasites of all kinds were imported from North and South America. From exhaustive tests there emerged a faint ray of hope in the shape of "Cactoblastis cactorum." Soon this stout-hearted little insect began to be regarded as Australia's "white hope" in the fight with the pear. He is extraordinarily prolific; he is a most accommodating insect; and yet he is very particular in his diet, and shows a marked partiality for the pear —so marked, indeed, that he will eat nothing else. He was soon acclimatized and has been easily established.

THEN, however, arose the necessity for investigating the adaptation of Cactoblastis to Australian conditions, and of his immunity from natural enemies. Climatic changes affect the welfare of moth caterpillars in general. Excessive rains, for example, bring diseases; but Cactoblastis has shown great hardihood in these circumstances, whereas extreme dry heat is a severe trial to him. Again, certain Australian parasites and predatory creatures have turned their attention from native hosts to the new arrival. These enemies and their effect are being carefully watched. Where a vast number of caterpillars of Cactoblastis have been congregated in a limited area, however, they have been practically immune from bird attack.

The Commonwealth Prickly Pear Board and the Council for Scientific and Industrial Research now believe that the end of the pear is in sight. Nearly 100,000 dollars a year is being spent on behalf of Cactoblastis in his battle with the pear, and he is winning all along the line. The war is being watched with intense interest throughout Australia and by entomologists throughout the world. At frequent intervals bulletins and communiqués are issued by the Board detailing the results of the latest attack on some particular salient, and noting the health and fighting disposition of the troops. Immense reserves are in hand, and the front line armies are constantly being reinforced. Only five years have elapsed since the first 2500 eggs were brought to Australia from Uruguay. The consignment proved an immediate success; the caterpillars thrived on the pear and produced moths that deposited 100,000 eggs. The second generation yielded 2,540,000 eggs. From October 1927 to June 1929, in Queensland alone, in the main pear area, 220,000,000 eggs were liberated and distributed, and in 1930 the Board liberated 500,000,000 eggs.

The havoc which Cactoblastis is wreaking on the pear is marvelous to behold. Soon after the attack begins the plant becomes yellow and sickens. A few months later the entire plant has rotted away, only skin and fiber being left. Any new shoots which may spring up are, in their turn, attacked, and soon perish. The female lays eggs in sticks about 1½ inches long, holding an average of 75 eggs, which hatch twice a year, taking from three to six weeks to develop. The caterpillars pass their existence within the pear segments; they attain a length of about one inch, and live in colonies of 20 to 100. When full grown they spin loose white silky cocoons, which have a duration of about five weeks. The moths live only for a few days. The caterpillars eat out the interior of the pear joints, tunneling from joint to joint. In the younger segments, the whole inside is eaten, leaving only the thin papery cuticle; older pads are not destroyed entirely, but wet rots, caused by various fungi and bacteria finding suitable conditions for development, hasten and complete the destruction. The caterpillars may even penetrate into the underground bulbs and roots, and with the aid of the associated rots the clumps are entirely killed.

GREAT numbers of eggs may be laid in a limited area, even 1,000,000 eggs an acre. With this vast quantity of caterpillars feeding, and enabling rot conditions to develop, the spectacle is afforded of the pear collapsing and dying as though visited by some virulent plague. The host of Cactoblastis now in Australia numbers many thousands of millions, and this vast horde has sprung from the original 2500 eggs introduced in May, 1925. The terrific work of destruction proceeds silently, continuously, incessantly. It is suggested now that, besides devouring the pear, Cactoblastis communicates to it some disease.

CHANGE—THE GREAT COMPETITOR*

By **RAYMOND WILLOUGHBY**
Of the editorial staff of *Nation's Business*

Courtesy The Detroit News

The Autogiro, the result of a new idea, has invaded the transport plane's field and is now in use by several firms

IT is immediately significant that the eagle is our national emblem. The carpet slipper and the easy chair have no place on our coat of arms. America is a nation definitely on the move. "Move on" is more than the directing text of our police departments. It is the most active coin in our national currency.

So characteristic is the itch to keep going that we find an articulate impatience with loafing. "Let's burn all the chairs, divans, davenports, and benches," urges W. A. Blees, vice president of the Oakland Motor Company, and justifies his inflammatory tonic with saying, "If burning the chairs did nothing but make the chair sitters go out and buy more chairs to sit in so they could comfortably complain about poor business, we would at least put a few people back to work making chairs."

Tree sitters, flag-pole perchers, and bench warmers have at times provided exclamation points in the news. But it is apparent that they have not written the declarations of our industrial independence. The business that says "I do not choose to change" is a bad risk, as many bankers and investment companies know to their cost.

Better services, improved products every day win converts from familiar services. Look through the advertising pages of any magazine. How many brands of trademarks were there 20 years ago—five years ago? Probably the magazine itself is not that old!

A nation is as young as its ideas. Every business has two junk piles. One inside the walls, the other outside. Good times or bad times, depreciation and obsolescence of plant and equipment are always on the job and many good heads have been put together to work out the retirement of superannuated machinery. But it is becoming clear that too little thought has been given to the high cost of carrying on with outworn ideas.

An engineer of the General Electric Company strikes the keynote of industrial progress by saying, "Know what is best, what trends are, press relentlessly for modernization, install conscientiously, and maintain intelligently."

The American people have a new attitude toward life and the apparatus with which life is lived. That state of mind greatly affects the things they buy and consume. Its expression has been aptly labeled "the American tempo."

"It means," says Ernest Elmo Calkins, "that new ways, new things, new ideas are eagerly spread and eagerly assimilated, and that a semblance, at least, of that smartness which was once the prerogative of the privileged few, is now demanded by virtually all."

The manufacturer, the wholesaler, the retailer, the transportation companies, the bankers, the insurance writers—the whole vast organism that we know as business—must play up to this new national consciousness if profit and permanence are the goals. Business must be synchronized with the pace of today if it is to keep the pace of tomorrow.

Products and services must be seen in a new light by their creators and distributors if the public is to see them in a new light. The change in viewpoint is internal before it can be
comes by design. Change i
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ter way, the improved process
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And there is no lack of evide
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paid its way. The case of the
Manufacturing Company, for e
Edmund C. Mayo, its president, r
ed that the firm's chemical and physical laboratory saved 125,000 dollars the first year. "If your business won't support a research department," he said, "go into some other business."

In the old days a firm that established itself in a general way was rated progressive. Market domination is now only a matter of months. Labor, capital, raw materials, productive processes, marketing facilities can be marshalled quickly. They need only the spark of an idea to energize them into fruitfulness, and ideas are traveling faster and faster. Some day we shall see "new ideas" listed among the assets of going concerns. The business that pleads it doesn't have a chance means that it doesn't have a change maker. Even now an investment rating on "new idea" departments is in progress.

A NATIONAL investment organization has thought it worth while to report on the "new idea" facilities of the 40 business enterprises included in its portfolio. Notable achievements in savings effected, new products developed, and new industries created are also revealed.

Pointing out that ten years ago there were not more than 200 industrial laboratories in this country, and that today 1500 companies are spending 200 million dollars a year on industrial research, the report says, "in a decade science has become the mainspring of industry. It has reorganized, expanded, and revitalized modern business and lighted the way to vast industrial realms hitherto unexplored."

But the ways of the change makers are not always easy. The world must be shown again and again, for the old is tenacious. It took 18 years to get the first million automobiles on the road. Two years to get the second million in the public's hands. One year to put the third million in use. But in a generation the national registration has risen to 26 million motor vehicles. It took only seven years to sell 13 million radios, and sales of electric refrigerators multiplied one hundred times in seven years.

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*Reprinted by permission from *Nation's Business.*

America's hospitality to change is *everywhere apparent. One third of the* factory output, the word goes, is of goods entirely unknown 50 years ago. A sharper focus of fact is at hand in the General Electric's report that items developed in the last ten years constituted 25 percent of its sales in 1929.

Call the roll of American industries and you will find that where there is leadership there is change. A crystallized management is no match for a fluid market.

The way of industrial salvation through change is ably exemplified in recent business history. The Union Carbide Company, for an object lesson. Once Prestolite was its big product. Electric starting and lighting for motor cars cut sales. The company turned to making radio batteries. They sold well. Then the electric radio sets began to dominate. The company went to work on radio tubes, health lamps, and related products using carbon elements. Change, change, change, but the company is still going strong.

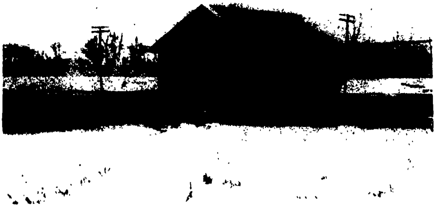
THE Radio Corporation of America is another great change maker. It began as a holding company for radio patents. Then it licensed builders of broadcasting stations. The manufacture of radio sets and tubes was an easy step. Was an inducement needed for the public to buy? Well, it would provide programs. Were the movies a competitor? Why not go into the theater business and take over vaudeville? The Keith-Orpheum circuit was bought. Along came the talkies threatening to kill radio, movies, and vaudeville, and the corporation found a profitable voice. Growth by accretion, advance by absorption, progress by projecting the present. So, too, with General Electric, General Foods, du Pont, and Sherwin-Williams. When the United States Steel Corporation made up its collective mind that cement was a competitor it bought out the Universal Company.

The versatility of the Hercules Powder Company is a case in point. Explosives lost their market at the end of the War, and the company decided to try "naval stores"—rosin, turpentine, and pine oil. Its turpentine campaign aimed at paint and varnish makers fell short. It found that nine million of the 12 million gallons sold annually went over retail counters, chiefly to painters. It learned that turpentine had been sold from the barrel—no brands, no trademark, nothing to give distinction. Why not break down the container to five gallon, one gallon, and one quart sizes, package it attractively, put on a distinguishing mark, and go after the consumer? Answered as indicated, sales increased 81 percent and a larger plant was required.

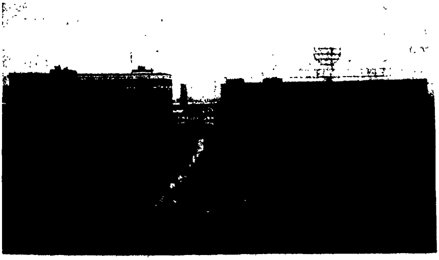
Among the old industrial faces that have put on new makeup, none perhaps is more remarkable for change than aluminum. Long a mainstay of pots and pans, aluminum and its alloys now figure prominently in the metal working industries. Through the intelligent legerdemain of the change makers, notably the Aluminum Company of America, aluminum has become important in the manufacture of airplanes, automobiles, railway cars, and locomotives. Intensive experiment and study have made *a place for aluminum in the manufacture* of metal furniture, power transmission equipment, oil burners, and spray painting devices.

Aluminum's new place in the construction sun is conspicuously revealed in the façades of certain new buildings; as a shining example, the A. O. Smith Building, Milwaukee. Five million aluminum hub caps are now used on automobile wheels. The development of "Alclad," an aluminum alloy, made possible the construction of the *ZMC-2*, "the world's first all-metal dirigible," built at Detroit for the United States Navy. Aluminum paint is a commonplace, yet the ability to change the familiar bluish silver surface of aluminum to desired shades is a fairly recent laboratory triumph. Where color is demanded—as it seems to be in products of every sort—the industrial hue and cry puts a literal emphasis on the chromatic scale.

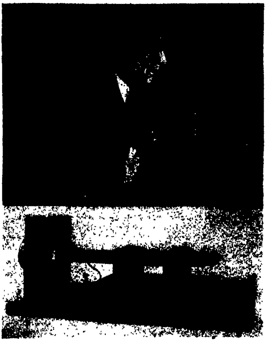
How new steel products are modifying building practices is a matter of more and more concern to architects, engineers, and contractors. New "rustless" steels are being fabricated into outside wall panels which include the window frame, sash, sills, and even the heating unit. By use of this design, structural sections may be more economically assembled in the shop than on the job.



Scientific research has firmly established itself as the backbone of business. The photograph above shows the research laboratory of the General Electric Company in 1896; the one below, the modern buildings devoted to research in 1931



"Rustless" and "stainless" steels are inviting use where their nonoxidizing properties are decisively valuable, as for chemical storage tanks and filters, for silos, in the preparation of foods, in metal mining and reduction works, in pasteurization processes, pumps and pistons. The idea of all-steel buildings now in a way of practical translation holds important commercial implications for cement, stone, brick, and lumber. Long a mere bearer of burdens, steel has been touched by the change makers and made into a thing of beauty.



Organized research has raised the telephone from this crudity to the present efficient unit

If one thing cannot be changed to improve sales, perhaps another can. Noses, for illustration. A maker of silverware found himself almost in bankruptcy because the fancy boxes in which his goods were packed smelled bad. The glue was the offender. A change of container restored his ware to good standing.

This idea of deodorizing is more than an industrial footnote in its relation to leather and linoleum. Laundry soap, wall finishes, and raincoats are taking more and more notice of the sense of smell. Theater interiors are scented and probably it could be demonstrated that houses have been sold by the smell of new paint and varnish. Perhaps it will turn out that some books have been censored more for the odor of their inks than of their contents. The olfactory nerve has been known to control the pocket nerve.

ONCE it was an industrial fashion to look on by-products as poor relations but not rarely by-products have outdone the main line. The examples are legion. Blast furnace slag is now used in the manufacture of cement. A by-product of baking powder is used as a binder material in building construction. Possibly the meat packers provide the classic example of the prevention of waste. Now that the court decree which kept them out of the retail food and meat trade has been modified, wholesalers of those products face a sharper edge to competition from a new source.

The courts, legislatures, and governments all have a hand in revising the economic pattern. They introduce the "X" factor, the unknown quantity, into the business equation. It is one thing to know about the existence of their modifying influences. It is quite another—and far more important—to have at hand the interpretation of their meaning to business.

The recovery of greases and animal foods from garbage puts a changed accent on thrift. Cheap fertilizer filler is also produced from this waste. Where change is the rule, it is easy to believe that city dumps will be able to match the reduction of refuse with the reduction of taxes.

Changes in the ideas of "farm relief" are more or less apparent on the agricultural front. Arthur Little, Inc., chemists and engineers of Cambridge, Massachusetts, have reported frequently on the industrial utilization of agricultural wastes. No one seems to know the tonnage. Estimates range from 500,000 to one billion tons a year. These wastes include cereal, flax and rice straws, sugar cane, bagasse, cornstalks and cobs, oat and peanut hulls, cull potatoes and lemons, beet sugar residues, and fruit pits and skins.

MANY of these wastes are so closely related chemically to products in wide demand—such as starch, alcohol, paper, pyroxylin lacquers, rayon, and several types of building materials—as properly to focus attention on ways to recover potential values yet unrealized.

Naturally there is a broad divergence of opinion over the economic possibilities. Some views see a deterring limitation to profitable reclamation; others profess to see great wealth through conversion of many familiar by-products.

However, it is evident that "idea men" have been sharpening their pencils and figuring on ways to turn waste into money. These change makers have transformed wheat straw into corrugated board for shipping containers, made cellulose from cornstalks, converted sugar cane bagasse into building board, derived insulating material for houses from the straw of seed flax. They have worked peanut hulls into fibrous fillers for building materials, recovered starch from potato culls, wrested cooking oils from cotton seed, and won citric acid, lemon oil, and pectin from lemon culls.

In the Middle West much thought and energy are given to the wealth latent in the waste material of corn and wheat. Get out the cellulose, and there is the stuff of which various types of paper and rayon are manufactured.

Furfural—used in plastics and varnishes—is produced from oat hulls and corn cobs. Pectin for jellies is now extracted from apple cores and skins which canners formerly threw away. Alcohol and glycerine are now recovered from molasses formerly discarded by sugar companies. The chemists change the fate of old industries and create new ones while you wait.

If your business is at all concerned about its life extension, it is worthwhile to brush up your own ideas daily and see a "new idea" man at least twice a year. On all fronts industry is pushing forward to find new markets for staples and broader uses for by-products.

LOOK at the glass makers. They have widened sales by changing their traditional lines. Now they are making containers for the packing industry, glass pipe for the chemical industries, glass coal chutes, and insulating and heat resisting products in competition with porcelain and mica. Glassware for cooking, and non-shattering glass for automobiles are no longer novelties, and glass bricks for building are beyond the laboratory stage.

Rayon, too, has worked many changes. It worked a profound effect on cotton textiles, revising markets and methods of manufacture. It stimulated the maker of wood fiber to develop a new and highly purified product as a substitute for cotton rags used in paper making, and for the use of rayon manufacturers in place of cotton linters. The cotton textile people levy on expert minds to turn up new uses for cotton cloths.

It is true that competition's other name is change, and necessity is the mother of progress. Witness the makers of rubber tubing who were about to lose piano makers as customers. The tubing cracked and rotted too quickly. Its makers found an antioxident that increased its life ten times, and the market was held. Germany, rich in coal but poor in petroleum, contrives a motor that uses pulverized coal for fuel. Londoners complain of noise and a rubber-coated street is laid down, cutting the din 30 percent.

It is commonly observed that patents and processes are the key to industrial leadership. Market security sometimes comes by way of finding a voice for special pleading—as the toy industry did when it got the "mamma" doll to speaking throughout the land. Before 1925, Germany supplied most of the toys for American children. Two years later native inventiveness and salesmanship had captured the domestic market and were exporting in volume.

Quick-setting cement grew out of the need to cut the time on highway construction. Half a dozen American companies saw opportunity in this necessity, and their brands are on the market. Pressure on high value space in metropolitan business areas gave birth to companies specializing in the manufacture and distribution of steam. Space for coal bunkers, boiler rooms, and chimneys is released for revenue.

This promptness to accept opportunity has examples without end. For one, the brilliant success of Cason Calloway in building a great business from cotton waste. Employees of his father's textile mills had frequently suffered injuries to their hands by using cotton waste to wipe machinery. The laboratory prepared a wiping cloth with the waste material. A national survey revealed that 10,000 industrial plants needed such a cloth. Some could not install their own laundries. The Calloway mills agreed to provide service through local laundries. A dollar and an idea founded the Valley Waste Mill. Half a dozen other enterprises have issued from it. Last year they did a business of more than nine million dollars in tire fabrics, cotton trousers, and duck cloth.

Another industrial footnote is daily on view in the dull finish of women's stockings. Not so long ago, women began to turn their silk stockings inside out. They said they liked the lustreless side for a change. Some manufacturers immediately bowed to this whim of fashion, and turned to harder twist yarns. But the new stockings shrank more, and that made a problem for the laundry owners. They put it up to the American Institute of Laundering, and a new method of washing was developed. A caprice of fashion, a new product, a new problem—a chain of changes affecting one business by its influence on another.

THE idea of providing gas to rural dwellings got nowhere until chemists captured the butane and propane which escaped in the manufacture of gasoline. Waste gases once, they are now put in steel tanks and distributed to consumers who have no access to gas mains. The long distance piping of natural gas is itself a change that has come in the last two years. Before the perfection of new welding processes, a 250-mile pipe line was about the maximum. Now distribution 1300 miles from the source has been achieved. Manufacturers of steel sheets and tubes have been quick to get in the market. One of the first to realise the possibilities was a famous maker of automobile frames.

What these underground carriers mean to the railroads in loss of traffic in oil and gasoline no one seems to know. Now there is talk of using them for moving pulverized coal.

Knowing the public's mind before that mind is made up has been the salvation of many a manufacturer. Johns-Manville put its faith in asbestos shingles, but its managers sensed a growing demand for asphalt shingles, and so put them in production to fortify its sales position. The National Lead Company's record also accents the virtue of industrial flexibility. Sales to paint makers never tested plant capacities. Radio batteries once accounted for 10 percent of the sales. Electric sets cut into the market. A new outlet was found in storage batteries for industrial trucks and delivery wagons.

It may be that the depression was the salvation of pewter, for it is generally evident that many dealers in solid silverware have added pewter ware to their lines. In the industries silver faces ingenious competition from other metals —nickel, Monel Metal, and chromium, to name a few.

No industry, perhaps, pays more devoted tribute to the spirit of change than the automobile business. At this year's show it displayed a fresh bag of novelties—air foil fenders, double and down-draft carburetors, fuel pumps instead of vacuum feed.

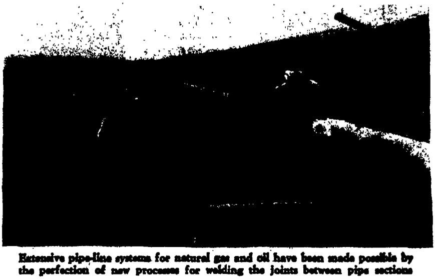
WHAT does it all mean on the balance sheets? Well, one manufacturer reports that 2000 of his new 16 cylinder cars were sold in nine months, and another announces that his free-wheeling feature raised his car from tenth to fifth in sales volume.

Possibly the motor makers have taken their cue from one of their own great change makers. It was Charles F. Kettering, head of the General Motors Research Laboratories, who recently stated:

"There is no place where you can sit and rest in an industrial situation. It is a question of change, change, change, all the time. Don't try to make progress in steps. It won't do. You have to keep in phase with the times. . . . You can't stop the thing called progress, but you can get in harmony with it."

This keeping "in phase with the times" has invited the attention of a national financial service. It ticks off the new props to our standard of living with this staccato recital of progress:

NATURAL gas and pipe-line developments; a radio crime service which will send an automobile instantly speeding to the source of crime; frozen foods; Dry Ice; greater use and development of electrical power; the airplane industry; film phonographs; rustless metals; smokeless fuels; heating by radio; artificial ventilation; humidified indoor air; the electrification of railroads; centralized heating and cooling systems; central newspaper plants, flashing newspaper pages by phototransmission across the country; electrically made steel, electric welding; the practical development and application of television; steel edifices instead of brick; the use of glass brick; the use of chromium, copper, bronze, aluminum, rustless steels for building exterior; steel constructed residences; low cost standardized houses manufactured and distributed by mail-order houses in parts; steel floors in construction, surfaced with tile; ice engineering with the control of climate evils; electric ships; the welding and fabrication of steel floors for tall buildings, with weight much less than at present; windowless structures; artificial lighting rich in ultra-violet rays; the cooling as well as heating of homes and offices; new and improved processes for the manufacture of wrought iron, steel, and so on; the practical use in countless directions of the photo-electric cell; and a thousand new inventions and developments for greater uses of electricity, are among the things to which the genius of the nation is being applied in the great research laboratories.



Extensive pipe-line systems for natural gas and oil have been made possible by the perfection of new processes for welding the joints between pipe sections

SULFUR*

By W. L. WHITEHEAD

Special Lecturer in Geology, Massachusetts Institute of Technology

SINCE the first use of gunpowder in warfare sometime in the 14th Century, sulfur has been of importance to the chemical industry of man. Earliest mining was confined to scattered volcanic deposits of small extent; and not until the discovery of methods of manufacture and utilization of sulfuric acid in England and the consequent development of the Sicilian sulfur deposits did the element become of definite commercial interest. In 1839, with the granting of a monopoly of Sicilian mining to a French company, English acid manufacturers turned to Spanish pyrites, containing some 48 percent sulfur, for a part of their needs, and these two sources alone also served American manufacturers in the late 19th Century. The Sicilian product, mined from beds of limestone and gypsum by shallow underground workings or open pits and extracted by melting in furnaces, was imported to the United States in 1895 to the extent of 165,000 tons. Close control of the native sulfur production and high prices existed, how- n these days and had encouraged American initiative i for home sources of the element.

SULFUR had been discovered in 1869 while drilling for oil in the marshes on the Gulf Coastal plain n Calcasieu Parish, Louisiana. Here, at about 600 feet, the drill had encountered sulfur-bearing rock; but the swamps and beds of quicksands below the surface had caused failure of all attempts to sink shafts.

The discovery finally came to the attention of Herman Frasch, chief chemist of the Standard Oil Company, and in 1891 he devised and patented a method for extracting the sulfur by wells. He believed that super-heated water introduced under pressure into the rocks from the type of well usual in petroleum extraction would melt the sulfur at 239° Fahrenheit and that the molten sulfur could be pumped to the surface. Before tests could be begun, however, Frasch had skeptics to convince and at last when operations commenced the quicksands again gave trouble in the drilling of wells.

Not until 1901, when Captain Lucas drilled the first successful oil well on the Gulf Coast at Spindletop, Texas, by means of a new rotary method of drilling, were the coastal quicksands easily penetrated. The Louisiana sulfur development then advanced rapidly. Plant design and erection were accomplished and in 1903, after prolonged heating of the ground by hot water, Frasch opened the valves of his pump line and saw molten sulfur flow from the wells. (The Frasch process was described in last month's number, pages 309-310—*Ed.*)

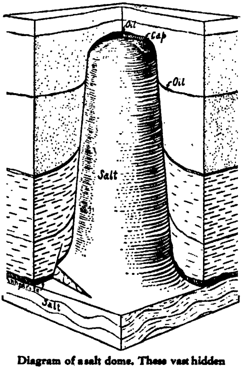


Diagram of a salt dome. These vast hidden domes are three or four miles in height

The size of installations in recent exploitations of sulfur may be illustrated by the Bryanmound development in Texas. Here boilers in the plant have a rating of 16,800 horsepower and may be operated at twice the rated capacity. The plant consumes 24,000,000 cubic feet of natural gas and uses about 7,500,000 gallons of specially treated water daily. About 1200 wells have been drilled on this property of 786 acres, including wells used as "bleeder" wells, from which water at 180° Fahrenheit is extracted from the sulfur rock to control pressure. At the Hoskins Mound plant this water, as well as flue gases and exhaust steam, is used for preheating the 5,000,000 gallons of water introduced into the ground per day.

Louisiana has now long ceased to produce sulfur, but new discoveries have been made in Texas to sustain and increase the production on the Gulf Coast. These discoveries have been due to the knowledge of the geology and occurrence of sulfur obtained during the development of the Louisiana deposit and during the intensive drilling for oil in the coastal region which began in 1901 with the discovery of the Spindletop field.

Along the marshy level prairies of the Gulf border in Louisiana and Texas, elevations of only a few feet are visible for long distances. Spindletop was one of these ising 20 to 30 feet above the plain. It had been drilled with the idea that such eminences had some connection with underlying bodies of salt and that oil might occur in the salt bodies, some of which had been mined in Louisiana. Spindletop proved a large producer of oil and drilling was carried out on many other coastal mounds.

THEY were found, as expected, to be underlain by salt at considerable depths, but the petroleum occupied cavities and porous areas in beds of limestone, gypsum ($CaSO_4 \cdot 2H_2O$), and anhydrite ($CaSO_4$) overlying the salt and capping it. Above these cap rocks were the soft sands and clays typical of the coastal belt. The cap rocks and upper surface of the salt were arched, roughly circular in plan, and varied from one eighth of a mile to two miles in diameter. These structures, the salt domes, are now known to be the cause of all of the sulfur deposits and of most of the petroleum occurrences of the Gulf Coast.

Developments of the last 30 years have given much information regarding these peculiar salt bodies. Not only from the records of wells drilled, but by geophysical investigations permitted by the relative density of the salt, cap rock, and surrounding sediments, by gravity determinations, and by seismograph, their positions and shapes have been studied. Today some 200 salt domes are known and a clear idea of the characteristic form and occurrence has been obtained.

The arched cap rocks lie at depths varying from a few hundred feet to

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*Reprinted by courtesy of the *Tech Engineering News.*

several thousand feet below the surface and may even be exposed at ground level in rare instances. The thickness and composition of the cap rocks also vary. The sulfur dome in Louisiana has a cap 11[illegible]0 feet thick, strongly arched, with its top only 350 feet from the surface. Other domes have thin caps overlying the typically lesser arched salt surface. Limestone is present in most cap rocks and is usually found nearer the surface than underlying anhydrite. Gypsum also may be present, perhaps interlayered beds between the limestone and anhydrite. The flanks of the salt mass are steep. Dips of the salt border increase from the flat top to angles near the edge that may reach the vertical. Overhanging projections even have been discovered by the drill. The flanks of salt are in direct contact with the surrounding soft sediments of the Coastal plain to the greatest depths drilled at present, about 8000 feet. The salt dome is thus a pipe-like mass of salt capped by hard porous rock and surrounded by sedimentary formations bent up on its flanks.

THE origin of these bodies is believed to be from a thick bed of salt at great depth. Such beds, 1500 feet thick and covered by beds of anhydrite, occur in western Texas near the surface. Folding of the rocks and pressure from the great thickness of overlying sediments are believed to have caused flow, such as occurs in glaciers, in this deep-lying salt bed and to have forced the salt into the soft superincumbent sands and clays. The plug-like mass has probably carried fragments of overlying beds of anhydrite and limestone upward on its top during the slow movement of penetration and these fragments, greatly crushed and distorted, constitute the present cap rocks. Geophysical work indicates that the salt beds lie at depths of not less than 15,000 to 20,000 feet.

Petroleum occurs related to the salt domes both in the porous cap rocks and in porous bent-up sands near the salt on the flanks. Associated with it are salt waters containing hydrogen sulfide. The sulfur is found only in the porous cap rocks and in relatively few salt domes. It occupies cavities and fractures in contorted beds of limestone or gypsum above solid compact anhydrite. The greatest thickness of sulfur-bearing rock is usually near the edge of the cap rock, although some good deposits existed on the flat top at Sulphur, Louisiana, and at Bryanmound, Texas.

The origin of the native sulfur has caused much discussion. Recent investigations by Dr. Waldemar Lindgren and the author indicate that considerable quantities of calcium sulfate have been altered in the cap rocks to calcium carbonate, limestone, by the action of sodium bicarbonate waters flowing into the cap rocks from water-bearing zones in the surrounding sands. It is quite probable that the hydrogen sulfide waters of the deeper flanks may rise on the salt contact, meet the carbonate waters and, on mixing with them in the zone of alteration of calcium sulfate, precipitate the sulfur contained in solution as sodium sulfide in the form of native sulfur. Precipitation of sulfur by bacteria has also been suggested.

With the development of geological knowledge of the occurrence of sulfur, new discoveries were made. In 1912 Bryanmound, Texas, was prospected and with its exploitation the American monopoly of the Union Sulfur Company, the owners of the Louisiana dome, ceased to exist. Later the sulfur-bearing salt domes at Hoskins Mound and Gulf, Texas, were opened up and in recent years the smaller developments at Palangana and Long Point and the great deposit at Boling, all in Texas, were put into production.

As a result of early discoveries, sulfur output in the United States rose to 2,036,097 long tons in 1923. After this time considerable reduction in production was caused in 1924 by the exhaustion of the Sulphur, Louisiana, deposit, but increase continued through later years to a maximum in 1929 of 2,362,389 long tons. These figures may be compared with Sicilian sulfur produced in the same year to the extent of about 200,000 tons and Japanese production of somewhat over 65,000 tons.

In 1929 the United States exported 855,500 long tons of sulfur and consumed 1,582,000 tons. Utilization of this quantity was distributed as follows:

Heavy chemicals	560,000 tons
Fertilizers and insecticides	415,000
Pulp and paper	265,000
Explosives	67,000
Dyes and coal tar products	47,000
Rubber	43,000
Electro-chemicals	23,000
Fine chemicals	15,000
Paint and varnish	5,000
Food products	5,000
Miscellaneous	137,000
Total	1,582,000 tons

THE use of sulfuric acid is widespread in industry, large quantities being required in petroleum refining, in iron and steel treatment, and in metallurgy. Therefore, although the sulfur mining industry ranks only 17th in the United States in the value of its product, it affects a most varied list of manufactures and the consumption of sulfur serves as a first-rate index to business conditions.

The future of this extraordinary mining in the liquid form is of considerable interest. Some apprehension was felt in 1924 with the closing of the Louisiana plants as to possibilities of maintaining large sulfur production on the Gulf Coast, but more recent developments have tended to a more optimistic outlook. Although but seven commercial sulfur domes have so far been found in about 200 known salt domes, many domes have been inadequately explored and future discoveries are probable.

Illustrations courtesy Freeport Texas Company

Molten sulfur is pumped under pressure from the subterranean deposits into [illegible] bins of wood. Here it cools, solidifies, and is broken up for use

¶ *This is the second of three related articles on salt, sulfur, and petroleum from salt domes, the first having appeared last month. The third article will have to do with the geophysical methods employed by the modern petroleum geologist in working out the hidden sub-surface structure of the rocks. We shall go into the field with him and see him at work.* —The Editor

CLEMENCEAU AND FOCH

The United States Enters the War: The Armistice: The Peace Conference

By **CAPTAIN W. D. PULESTON**
United States Navy

(Continued from May)

As soon as it was apparent that America would actively intervene in the war, both England and France began urging that American contingents be sent over as battalions of infantry to be brigaded with the English and French armies. They contended that incorporating American soldiers directly into the veteran divisions of the Allies would give the greatest amount of assistance at the earliest possible moment. The real obstacle to this procedure was that American soldiers would never be at their best commanded by foreign officers. President Wilson and Secretary Baker realized this and in Pershing's letter of instructions embodied the following: "In military operations against the Imperial German Government, you are directed to co-operate with the forces of the other countries employed against the enemy; but in so doing the underlying idea must be kept in view that the forces of the United States are a separate and distinct component of the combined forces, the identity of which must be preserved."

In the crisis of March, two days after Foch took over the French-English armies, General Pershing placed his army unreservedly at the disposal of Foch for the duration of the crisis, but insisted upon resuming the creation of an autonomous American Army as soon as the crisis was passed. Lloyd George and Clemenceau both renewed the demand that American troops be used in Allied divisions, and when Pershing would not yield they instructed their ambassadors at Washington to urge President Wilson to intervene, and were prepared to suggest that Pershing be removed if he continued to deny their request.

Foch would have nothing to do with this plan to coerce Pershing; and in October when Clemenceau again urged him to put more pressure on Pershing, he pointed out that of 30 American divisions fit for service, 10 were shared among the French and British, and 20 were formed into the American Army under Pershing. Foch appreciated the reluctance of soldiers to serve under foreign officers; Clemenceau in his ardor only desired to find replacements for the battle-scarred infantry of France. He was as exacting of the British, and learning of the number of soldiers retained in England as unfit for service abroad, demanded the right to send a French officer to verify the list. To show their good faith, the British authorities actually assented to this unprecedented request that a French officer inspect British soldiers invalided home to judge their fitness for returning to the front. On reflection, even Clemenceau was convinced of the unwisdom of such an undertaking and the request was dropped.

Photo Signal Corps, U. S. Army

When United States troops landed in France, there was much dissension as to how they were to be utilized. The arguments, and the decision reached, are put forth on this page

On August 8, Haig began an attack on the German front with the British Army that did not cease until November 11, at Mons. In September, Pershing, in personal command of the American Army, reduced the St. Mihiel salient, and in October began the advance through the Argonne that ended in the neighborhood of Sedan on November 11. In between these armies advanced the French Army until it reached Sedan on November 11.

Clemenceau complained that Foch would not command Haig and Pershing, but only advise them; and it is true that Haig submitted his own plan of advance for a plan suggested to him by Foch, who accepted the modification. Foch's conciliatory attitude with Haig and Pershing was incomprehensible to the fierce Vendean who had devoted the prime of his life to pulling down cabinets. Foch finally reminded Clemenceau that as Allied Commander-in-Chief he was not subordinate to the French Prime Minister; this caused Clemenceau to give Foch a sharp warning about listening to bad advisers.

THESE differences were comparatively minor but in September, Foch, sensing the impending German collapse, told Clemenceau that the end of the war was near and asked what the peace terms would be, so that the necessary military measures could be taken to secure them. Clemenceau tartly replied that he would manage the peace terms; and the rift between the two widened. It was natural for the trained, studious Marshal, who despised improvisations, to look ahead and to inquire of the political head of his Government what the political objectives were so that he might plan to secure them. It was equally natural for Clemenceau—whose father had revolted against Napoleon III, who was mayor of Montmartre during the 1870 Commune, who for over 30 years had been on guard lest a popular soldier overthrow the Republic—to take fright, when Foch, the successful Generalissimo, who was rapidly ridding France of the detested Germans, showed an inclination to take an active part in the peace making. After this difference the relations between the two steadily grew worse.

On October 8, Foch again asked to be informed of the policy of the French Government concerning the Rhineland; his letter contained the following paragraph:

"The occupation of the Rhine will put us in possession of pledges; but will these pledges suffice to guarantee reparations? When reparations have been made, what fate is in store for the Rhineland? Will France persevere in her idea of creating a neutral independent buffer state?"

(Please turn to page 423)

DIESEL VERSUS GASOLINE-ENGINED PLANE

HERETOFORE when men have voiced the opinion that the airplane of the future would travel at terrific speed from one side of the world to the other many miles above the earth's surface there has always been an immutable fact to arouse serious doubts in the minds of others, perhaps more practical. This fact has been that airplane motors must breathe and —just like humans—they cannot pull as much air into their "lungs," or cylinders, at high altitudes as at the earth's surface, for the air at altitude is more rare.

The flying man has known from experience that altitude affects the performance of gasoline engines adversely. He has scoffed at these visions of planes getting up into the rarer atmosphere and gathering unto themselves vastly greater speed through lowered resistance to their forward motion offered by the thinner air. He has done so because he has known that the speed of a plane equipped with any internal combustion engine up to the present lessens as the altitude grows greater.

An entirely new element, however, has been injected into the situation by the Diesel engine which has been developed for aircraft work by the Packard Motor Car Company and now is being produced. Through an inherent feature of the Diesel principle, the effect of increasing altitude on the Packard Diesel aircraft engine is exactly opposite to that on the gasoline engine. Performance of the Diesel engine grows better as altitude increases.

Whereas the speed of the plane equipped with a gasoline engine begins falling immediately as it goes to higher altitudes, the Diesel-engined plane gains speed. It continues to gain in speed up to a certain point and after that the rate of loss is considerably smaller than with the gasoline-engined plane.

In a recent test of two planes, this altitude performance for aircraft engines was said to have been definitely established. The test was made by a disinterested organization independently of the manufacturers.

One of the early flights of a Diesel-equipped plane which showed the reliability of this new power plant

Two planes of the same design were equipped, one with the Diesel engine, and the other with a gasoline engine, each engine having the same 225-horsepower rating. Although the Diesel engine had '200 cubic inches more displacement, the gross weight of the plane with the Diesel powerplant was 141.4 pounds lighter than the gasoline engine installation. In other respects there was practically no difference between the two planes.

The Packard Diesel engine gave a speed of 116.5 miles an hour at ground level, with the throttle set to give an engine speed of 1980 revolutions per minute. With the throttle unchanged and with no other manual adjustments, the engine speed increased to 2010 r.p.m. at 5000 feet altitude and the speed of the plane increased to 118.4 miles an hour in level flight. At 8000 feet altitude the speed had gone up to 118.6 miles an hour and the engine speed increased to 2015 r.p.m.

Above 8000 feet, the speed of the plane and engine began slowly to decrease. The plane continued climbing to an absolute ceiling of 20,000 feet where it had a speed of 82 miles an hour with an engine speed of 1750 r.p.m.

The gasoline-engined ship had a speed of 103.2 miles an hour at ground level with an engine speed of 1990 r.p.m. At 5000 feet the plane speed had fallen to 99.4 miles an hour and the engine speed to 1970 r.p.m. Engine and plane speed continued to decrease until the absolute ceiling of the plane was reached at 14,270 feet where the speed was 64 miles an hour and the engine speed 1745 r.p.m.

THE Diesel-engined plane at its absolute ceiling of 20,000 feet—more than a mile higher than the absolute ceiling of the other—still had 18 miles an hour greater speed, and had climbed at a considerably faster rate. Complete details of the tests are given in the tables on this page.

The reasons for the difference in altitude performance between the Packard Diesel and the gasoline engine lie in the difference in piston displacement, and the fact that the Diesel engine does not depend upon the same finely balanced mixture of air and fuel necessary for the gasoline engine.

The Diesel engine sucks only air into its cylinders on each induction stroke, instead of a mixture of air and gasoline as in the gasoline engine. This air is compressed so greatly that it is heated to approximately 1000 degrees, Fahrenheit. Just before the piston reaches top dead center (when in a gasoline engine an electric spark would leap across the points of a spark plug to ignite the mixture) oil is sprayed into the combustion chamber under great pressure. It is ignited instantly by the heated compressed air.

(*Please turn to page 424*)

The Packard Diesel-engined plane:

	Level		Climb			
	Speed MPH	R.P.M.	MPH	R.P.M.	Ft. Min.	
	116.5	1980	...	...	...	
5000	118.4	2010	79	1795	676	7.06
8000	118.6	2015	80	1820	617	11.69
10000	118.0	2010	80.5	1830	567	15.06
15000	110.6	1950	82	1830	390	25.47
Serv. Ceiling 19250	92.6	1810	82.3	1775	100	42.90
Abs. Ceiling 20000	82.0	1750	82	1750	0	

The gasoline-engined plane:

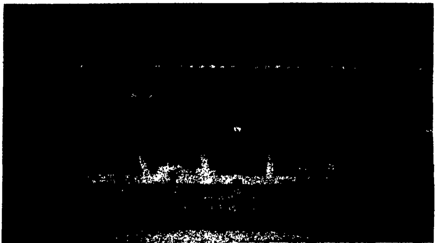
	Level		Climb			
Standard: Altitude:	Speed MPH	R.P.M.	Speed MPH	R.P.M.	Rate Ft. Min.	Time Min.
0	103.2	1990	61.2	1790	635	0
5000	99.4	1970	63.4	1785	412	9.7
10000	91.3	1905	65.0	1775	190	27.1
Serv. Ceiling 12000	85.7	1865	65.0	1765	100	100
Abs. Ceiling 14270	64.0	1745	64.0	1745	0	

Performance data of the two planes in the tests described here

A FLEXIBLE AMUSEMENT BUILDING

MUNICIPAL auditoriums are a good investment, as they tend to bring conventions and similar gatherings which benefit hotels and merchants. New Orleans, Louisiana, has solved its problem of a general utility structure in a novel manner, and at a cost of about 2,000,000 dollars. This cost is low considering that the auditorium seats about 12,000 persons. The building plot is approximately 360 feet square with an open area of the same size in front. By an ingenious system of rising proscenium walls, a concert hall can be thrown together with the auditorium section so that the combined seating capacity is 12,000 as noted. The main auditorium seats approximately 6500 people; about 1750 are seated in portable seats on the main auditorium floor. The seating capacity of the concert hall is 3500, about 600 or 700 finding seats on chairs on the floor. There are no columns in either the auditorium or the concert hall or in the entire arena when the two halls are combined and the stage is lowered.

Between the auditorium and the concert hall is located the stage which is common to both. The stage floor covers an area 50 feet wide by 129 feet long. Machinery actuating six screw jacks on each side serves to raise the stage section from the level of the arena floor to a high level for use in pageants and prize fights. The stage is of steel frame construction covered with planking, and is further equipped with a removable finished floor. The orchestra platform,



Upper Left: Picture taken from the concert hall looking towards the auditorium balcony. The movable ceiling panels are in a nearly closed position. The stage is lowered

Above: Auditorium and concert hall merged by the raising of the proscenium walls. The stage platform and the orchestra platform are raised for a pageant or fight

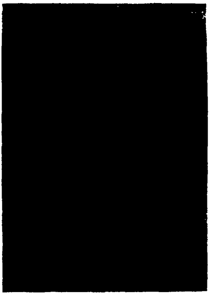
Eighty-five feet above stage level is a system of equalizing shafting and drums carrying the counterweighted walls

The basement holds the equipment for raising and lowering stage and orchestra. There are six jacks on each side on the concert hall side, is variable in height [illegible] a point three feet below the arena floor grade to the high stage level. With the stage, orchestra platform, and the arena floor at the same level, the entire floor area is approximately 92 feet wide by 180 feet long; the joints between the movable sections are close enough to permit dancing or any other use for which a permanent floor would be required.

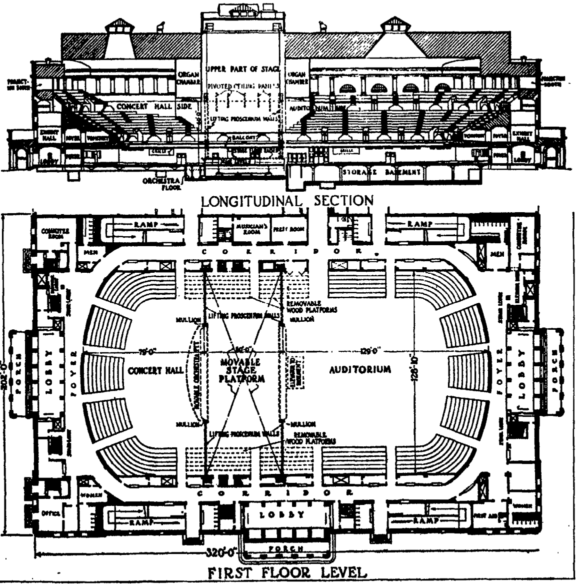
PERHAPS the most interesting feature in the whole building is the method of cutting off the stage at either side by means of counterweighted rising proscenium walls which give great flexibility of use to the structure. The stage area is closed off by means of movable walls of steel frame construction filled with sound proof material on the stage side and plastered on the other side. These movable walls make it possible to have the use of the stage for either the concert hall, or the auditorium, or both. The proscenium width can be increased to 90 feet by raising the two side walls and their dividing mullions. This system is used on both sides of the stage and is available either for the concert hall or the auditorium. If both of the main walls are raised a production may be viewed from both halls. To turn the building into a large arena it is only necessary to raise the walls, sink the stage and the orchestra platform to arena floor level, and close the pivoted ceiling panels. The walls are raised from the gridiron 85 feet above floor level.

The ceiling panels over the stage can be opened or closed at will to allow for the handling of scenery, electric light battens and so on, from the gridiron. All these operations are controlled from a push button cabinet so that all portions of the movable structure can be coordinated. An emergency stop button causes all motors to cease functioning.

The structure contains many other interesting features as will be noted by a study of the plan and section. We are indebted to the Allen-Drew Company of Cambridge, Massachusetts, for our illustrations and description of the system which they designed and installed.



All moving parts have remote control from this push-button cabinet which enables one person to cause all portions to function as required. An emergency stop button will stop all working parts if it is necessary



Motorized stage and proscenium walls of the Municipal Auditorium, New Orleans. An auditorium and a music hall can be operated separately or thrown together at will by lifting the proscenium walls and pivoting the ceiling panels

A TWO-MILE INDUSTRIAL WATER TUNNEL

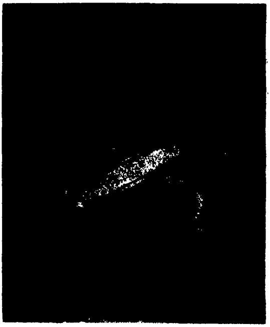
IN order that it may increase its capacity for immediate and future needs, the main power plant of the Ford Motor Company at Dearborn, Michigan, is undergoing several remarkable changes. These include the installation of two new high-pressure boiler units, a powerful steeple-type turbine-generator and turbo-blowers of increased capacity, and the construction of a water tunnel more than two miles long. The entire change-over is being handled without interruption of production.

The new boilers, which have a steaming output of 700,000 pounds of steam each per hour, will replace two boilers which generated only 500,000 pounds of steam each per hour. The unusual feature from an engineering standpoint is that this increase in steaming is to be had by installing the new boilers in almost identically the same space as that formerly occupied by smaller boilers which yielded only a fraction of the steam capacity.

The turbine-generator will have a capacity of 110,000 kilowatts and will replace two that afforded a combined energy of only 25,000 kilowatts. The new turbo-blowers will increase the air output by 30,000 cubic feet per minute to each of the plant's blast furnaces.

The tunnel, with which we are more concerned in this discussion, will have a 24-hour capacity of close to 1,000,000,000 gallons and will not only provide more cooling water for the condensers, but water at a lower temperature than has heretofore ever been available. Its exact daily capacity will be 913,600,000 gallons, amounting annually to 333,464,000,000, or over 80 billions of gallons more than is used in a like period by the cities of Detroit, Cincinnati, Washington, and Philadelphia combined. So far as is known it is the largest tunnel ever built to serve the needs of a single industrial concern.

Along the southern side of the Rouge plant area runs the River Rouge, which winds in a generally eastward direction to empty into the Detroit River. When the Ford Motor Company first occupied its present site, this was little more than a sluggish creek with a normal summer temperature of from 75 to 80 degrees Fahrenheit. Subsequently the stream bed was dredged for the admittance of large boats directly from the Detroit River to the Rouge plant.



At left: Front view of one of the hydraulic block erectors, showing the manner in which the huge blocks weighing over a ton each were placed in position

At right: The junction formed by shields 1 and 2 after the diaphragms were burned away. Note perfect alignment of the fin ribs resulting from underground survey calculations that are believed to be without parallel

A vertical, eight degree curve in the new Ford plant tunnel. The curve is 160 feet long and its drop is 19 feet

Water is now being drawn for plant and mill use from the upper end of a boat slip which was excavated at the edge of the plant. After passing through the condensers the water empties into the River Rouge only a short distance from the ship turning basin approximately one half mile away. In addition to this, water used for cooling and slushing in the steel mill, glass plant, and elsewhere, is also returned to the River Rouge, with the result that during summer months the stream temperature rises to between 84 and 87 degrees.

The increase in temperature over normal is only part of the difficulty, for the chief problem lies in the fact that the plant requirement is approximately four times the total flow of the River Rouge. This great demand results in the creation of a loop composed of an immense volume of water that is actually used over and over again. When the new tunnel is in operation it is expected that the intake water will average 71 degrees for the hottest months and range downward to a winter minimum of around 33 degrees. Furthermore, by using the present intake tunnels for the expulsion of used water

A total of 45,790 of these ring blocks was used in the new tunnel

the boat slip and the river will undergo a continuous flushing and the present turbid condition will be relieved.

Generally described, the new water tunnel is a true cylinder with an inside diameter of 15 feet and an outside diameter of 21 feet. Its lining is made up of two thicknesses, each 18 inches. The outer is composed of interlocking cement blocks weighing 3420 pounds each, 10 to a ring, and the sections of rings set one against the other. These blocks, curved in the molding process to conform to the arc of a cross section of the tunnel, constitute, as a whole, the entire outer tube. The inner lining is formed of monolithic concrete.

The tunnel is 12,000 feet long and is located 60 feet below the surface of the ground. It begins with an intake located on the old channel of the River Rouge at a point about two thirds of a mile from the Detroit River and ends with a pump well and house located beside the Rouge plant No. 1 power house. From the intake the tunnel passes under a dozen streets and main highways, street car and railroad tracks, bridges, a creek, and a cemetery.

When the lower ring of the pump well reached hardpan at 80 feet, 1200 tons of pig iron were loaded on its rim to test this foundation

The tunnel was excavated by the shield method, four of these machines working on the job. Each shield was circular in transverse section, 21 feet, 6 inches in outside diameter, 14 feet from the vizor-like cutting nose to the open tail, and built of steel with the shell 2¼ inches thick. Stepped back a distance of three feet from the cutting nose was a diaphragm placed at right angles to the axis of the shell, itself of heavy ribbed steel plates braced with angles. Six ports, or "pockets" pierced the diaphragm but these were reduced in size to an average of one square foot with the use of cross timbers. The advancing force was applied by hydraulic jacks so placed around the circumference border of the diaphragm as to push against the ring of concrete blocks last set in place. The jacks had cylinders 10 inches in diameter.

FOR the greater part of the job the work was in blue clay of the consistency of putty. As the jacks, pushing against the block ring, advanced the shield, the clay oozed through the diaphragm ports much as dental paste comes from a tube. As the clay was forced through, one of the two men stationed at each port cut off sections of it weighing from 50 to 100 pounds each. The second workman caught and tossed the severed chunks into electrically propelled tram cars.

Following the advance, the jacks were withdrawn and the next circle of blocks set in place by an hydraulic erector of the arm and ram type, with the "fingers" inserted in depressions provided in the concave surfaces of the blocks. The time required for the erecting of these rings varied but both the above and the placing of a ring was often accomplished in 45 minutes. The rate of progress may be indicated by the month of September when, working two shifts in each of two headings, the distance covered totaled 2160 feet.

It has been stated that each ring comprises 10 blocks, but this must be qualified, for every complete circle contains nine solid blocks and a tenth of equal size but molded in two parts, and so shaped that the erection of a complete ring of blocks could be accomplished without moving the erector. In the progression of rings the positions of these key blocks were staggered.

Propeller of one of the four booster pump units for the pump well

Counting the key block and its c panion unit as one, all blocks mea six feet in length, two feet six inches in width, and 18 inches thick. They were *made in material plants located convenient* to the job and poured at the rate of 430 every 24 hours. After pouring, every block was allowed to set for 12 hours before the forms were removed and the blocks themselves left undisturbed for a period of 18 hours. There then came a weathering outside the pouring plant. Through the next seven days they were sprayed with water 12 times every 24 hours and, following that, every four hours for a period of 21 days. After this 28-day weathering they were ready for transfer through the shafts to the tunnel floor tram cars. The number of blocks used on the entire job was 45,790, or at the rate of 3.4 cubic yards of concrete per lineal foot.

The 18-inch thick inner lining of the tunnel is of monolithic concrete throughout. Concrete used for the lining was at the rate of 2.88 cubic yards per lineal foot, or a total of 33,560 cubic yards for the job.

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

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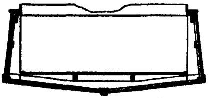
What We Eat

THE Department of Commerce informs us that our per capita diet has been changing both in kind and amount. From 1899 to 1927 there was a steady decline in the consumption of flour, corn meal, and rye and buckwheat flour. Meat remained steady, although beef consumption declined while pork and veal gained. Edible fats and oils found more favor, 14 pounds of lard and 18 pounds of other fats (17.2 pounds butter) and 12 pounds of vegetable oils (largely cottonseed and coconut) being consumed in 1927, whereas in 1899 only 32 pounds were consumed. Sugar consumption increased from 61 to 104 pounds; dairy products from 800 to 1040 pounds; and fresh fruit from 169 to 192 pounds. We use 1.8 gallons of edible molasses, and about 12 pounds of coffee and 0.8 of a pound of tea, against 3 pounds of coffee and 0.5 of a pound of tea in 1830. We eat about 11.55 pounds of candy annually. We chewed 106 sticks of gum in 1927, an average of 85 in 1920-24 and 39 in 1914. Of peanuts we ate 7.98 pounds, almost twice the amount of all the other nuts together, walnuts being next on the list with less than 1 pound.—*A. E. B.*



Typical section of the shallow-V-bottom boat, other sections being identical from the bow to the stern

A Shallow-V-Bottom Boat

IN very recent years there has been a very definite back-to-the-water trend in America due to the constantly increasing traffic on our highways which, for many people, makes automobiling unsatisfactory. Boating is taking a strong hold on the nation, and the imagination of inventive genius is being turned toward the development of marine equipment and boats.

A striking example of new boat construction is the cabin cruiser designed and patented by Mr. J. H. Crary, of Westport, New York. The principal feature of this design is the convex, or shallow "V," bottom which can be constructed at much less cost than ordinary hulls. By reason of the peculiar construction, straight pieces of planking are used throughout, no bending, curving, or cutting of any nature except that of cutting to length, being necessary. At all points from the bow where the keel curves upward to meet the upper deck all the way to the stern, the "V" sections of the bottom are identical; so far as construction is concerned, they are interchangeable. The sides of the hull are perpendicular to the bottom planks which causes the sides to incline inwardly, as shown in an accompanying illustration.

Mr. Crary has built a cabin cruiser by this design, 29 feet by 9 feet, weighing 10,088 pounds, and having comfortable sleeping accommodations for four people. The maximum speed expected of this boat was 16 miles an hour but the average of 10 tests was 24 miles an hour with a figured propeller slippage of plus or minus 10 percent. She is said to be a fair sea boat and she throws water away from her sides in such a way as to reduce skin friction.

Edema

EDEMA is one of the most serious symptoms associated with various disorders of the kidney, failure of the heart, and certain forms of under nutrition. In edema, fluid collects in the tissues to such an extent that a pit made in the skin by pressure remains because of the large amount of water present. All sorts of methods have been suggested for getting rid of this accumulation of fluid. Drugs are given which increase the output of fluid through the kidney, attempts are made to influence the glands of internal secretion, and the diet is modified in various ways. Recently Drs. W. S. O'Donnell and S. J. Levin have used calcium gluconate in an attempt to control edema in a number of children. Continued administration of this drug was successfully used, causing the elimination of much of the water. Increase of protein in the diet at the same time was helpful.

The modern physician is able through studies of the blood, the body weight, the urine and other factors in the body to control, almost like a test tube experiment, most of the actions that go on in the human system.—*M. F.*

Enlist Electricity To Battle Diphtheria Germs

ELECTRICITY has been found an effective aid to combating diphtheria, according to information furnished the Society of American Bacteriologists by W. T. Symanowski and Robert Alan Hicks of the Western Pennsylvania Hospital of Pittsburgh.

They reported that research disclosed that highly-potent diphtheria germs are greatly diminished in strength when subjected to electric waves at frequencies of 158,000,000 and 80,000,000 cycles.

American Rubber—Guayule

ABOUT three years ago—in our number for July, 1928, to be exact—the early development of a great guayule rubber plantation at Salinas, California, 100 miles south of San Francisco, was described at some length. That article, entitled "Can We Grow Our Own Rubber?" was written by our contributing editor, Dr. D. T. MacDougal of the Carnegie Institution of Washington. A follow-up on the same development may prove interesting to those who read the original article, as some of the

A cabin cruiser, 29 feet 9 inches long, built according to the design invented and patented by Mr. Crary desert guayule shrubs which are the source of guayule rubber have now reached maturity and a factory for rubber production has recently been built.

Three years ago, 2600 acres of the guayule shrub were under cultivation. Transplanting the seedlings, cultivating them in the field, harvesting them, and other processes, all are done by means of machinery in contrast to the methods employed in the Far East where the rubber is obtained from the latex of the *Hevea* rubber tree. There one native produces 1700 pounds of *Hevea* annually. In the American guayule harvest one man plus his machines annually produces 25,000 pounds. It takes the guayule rubber shrub four years to reach maturity when it is about 18 inches in height. The shrub is dug or pulled, dried, crushed, and placed in a tube-mill which extracts the rubber from it. (U. S. Patent 16[illegible]570, 1928.) The bark contains 80 percent guayule.

At the present time 25,000,000 guayule shrubs are growing at Salinas, a part of these having been planted each year, and it is the older shrubs which have now reached the harvesting stage. The daily capacity of the factory shown in one of the illustrations is 15,000 pounds of rubber—not a large factory, but large enough in the circumstances, the guayule industry being in its youthful stages. This factory will handle the 2000 acres of guayule shrubs which will mature each year for the next few years. The chief present use for the product has been for coating the cords of cotton used in making tire casings; also for inner tubes and as a component of tire treads. Guayule rubber is not the full equal of *Hevea* rubber, at least in all respects, but when properly prepared it "will compare favorably with it"—so says the Bureau of Standards.

In the meantime, the economics of guayule production have become partially involved, mainly through the very low present trend in prices of *Hevea* or plantation rubber. With plantation rubber at or near 6.5 cents, a very low figure, guayule has not been in so favorable a position as it might otherwise have been. The price in 1929 ranged around 20 to 25 cents; in 1930, 15 cents. According to Moody's Manual the gross income of Intercontinental Rubber Company, owners of the Salinas plantations, has fallen from half a million dollars (round figures) in 1928 to a quarter million in 1929; the earned dividends have fallen at the same time from 32 cents per share to nothing. The market quotations have ranged from 28 to as low as 2, although much of this drop may be laid to the general decline in the market. It is said to cost about 20 cents a pound to put guayule on the market. When *Hevea* is lower, guayule is in hard luck; when higher it is in good luck.

Just what this situation forbodes for guayule rubber is as uncertain as prediction always is. Whether an American rubber industry can sink or swim appears to be mainly contingent on the trend of production cost of plantation rubber. Former Secretary of Agriculture Jardine, writing in *Nation's Business*, calls guayule "the most immediately promising of all plants now thriving in the United States." But, he says, "the real botanical prize obtained by the Government is intisy, recently introduced from Madagascar." He refers to intisy as "the best rubber producer in the world." Commenting on probabilities he states that "the next few years will be interesting ones in American rubber production. Mr. Edison's machines may be developed to the stage where goldenrod will yield rubber profits for hay-fever vacations. Guayule may dominate. Intisy may develop best."

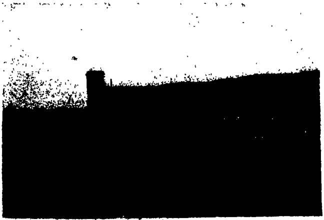
As far as goldenrod rubber is concerned, Mr. Edison has said many times that only a national emergency would permit its economical use, and that he would be satisfied if he could bring the cost of production down to two dollars a pound. But at this cost it would not be a commercial success.

It has been suggested that a reserve of several hundred thousand acres of guayule plants be created in this country, against an emergency, and left in the field. The plants grow indefinitely and their rubber does not deteriorate while they are alive. In case of war or other difficulty the nation could turn to this reserve. Just as a few extra hundreds of dollars, even if not used, "feel good" in the pocket when one is far from home, so a billion pounds of guayule rubber in this kind of live storage within our own boundaries would "feel good" to the nation.

Measuring The Efficiency Of A Cow

ELECTRICITY'S latest task is a boon to the dairy industry. In the laboratories of the College of Agriculture, University of California, at Davis, California, there is a "respiration chamber" in which the input-output efficiency of a cow may be tested electrically. In fact, provisions

Practically everything about bossy but her smell—if she has one—is analyzed in this laboratory: the food she eats, the milk she produces, and waste products



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The factory at Salinas, California, where guayule rubber is produced. Guayule promises an appreciable supply

View of the milling department in the factory shown at the left, where large-scale production may be expected

Intricately chased small objects, rings, et cetera, may be cast by the new process described here in which a flexible molding material is used for making molds

are made for tests on two cows at one time.

The animals are provided with comfortable stalls in air-tight chambers, and are fed, watered, milked, and cleaned under careful laboratory conditions. The feed is weighed, the water is analyzed, and the air in the chambers is cooled and humidified. Attendants who enter the chamber at regular intervals must pass through an air lock auxiliary chamber to prevent air leakage.

The breathing of the animals is measured by an elaborate "mechanical lung" device called an "aspirator," designed and built by Dr. Kleiber on the staff of the college. A classifier, in the basement under the respiration chamber, separates the waste products. About the only thing which is not analyzed by this machine is the cow's moo.

The entire equipment is about three times the size of a large motor bus, and it cost nearly three times as much.

The respiration chamber is equipped with many interesting scientific instruments for carrying on research projects. General Electric motors and control devices are used to operate the "aspirator" and the classifier. Through the use of the equipment, scientists may ascertain what effect, if any, the use of treated water, variation in diet, cooled air, or other controllable conditions may have on a cow's efficiency.

Oil from Cherry Pits

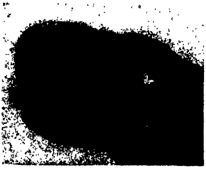
WHEN J. G. Marton, cherry grower of Sturgeon Bay, Wisconsin, stepped on a cherry pit a few years ago, he noticed the mashed seed kernel left a grease spot on the floor. Instead of canning cherries, he is now making oil out of nearly 1000 tons of cherry pits each year. The United States Department of Agriculture considered his discovery of sufficient importance to send two of its expert chemists to study the new industry, which began in a small way in 1927. The oil squeezed out of the seed kernel is used in making cosmetics, the residue of the kernel is ground up for fertilizer, and the shells of the pits are used as fuel.—*A. E. B.*

Seamless Undercut Castings Without False Cores

IN sand casting it is necessary to form the undercut places with false cores, producing seams on the casting which have to be removed by costly chiseling.

In a new German process introduced recently in this country, this work is obviated by covering the pattern with a plastic paste which will become elastic after a certain time. The pattern may then be removed from this elastic mold without spoiling it. The elastic mold is then put in its original position until it hardens. The mold is then put into an ordinary molding box, the customary inlets, pouring gullets, and vents being cut and the mold then dried and burned.

Castings made in such a way are seamless, very smooth and further finishing is seldom necessary. Very complicated castings may be made by this process and are said to be much cheaper than those produced in any other way.



The hardened mold and the model with its finely undercut details

Speeds Up Action of Yeast

PSYCHOLOGISTS tell us that music in the work-shop makes men work faster; illumination experts have proved that production is speeded up by good lighting. It remained, however, for the chemist to discover something that would speed up the action of that humble but useful organism, yeast. It has been found that rhizopin, a substance formed by the fungus *Rhizopus suinus*, greatly accelerates the growth of yeast. The effect is manifested both in greater formation of yeast dry matter and in increased conversion of carbohydrates to alcohol.

A convenient method for making rhizopin is to cultivate the fungus for six days at 35 degrees Centigrade [illegible] liquid glucose- [illegible] medium. The liquid is then filtered and sterilized in an autoclave; the resulting solution contains rhizopin. It may be used as such for accelerating yeast growth and [illegible] or it may be purified by precipitation with 10 times its volume of alcohol.—*A. E. B.*

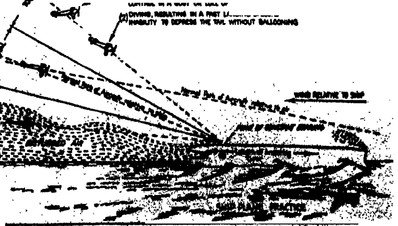
Deck Flying

THE American navy has always been inclined to great secrecy in the matter of its aircraft carriers, the methods of deck landings and the details of the arresting gears employed. So has the British navy up to recent times. Now the policy of secrecy has been broken by the British and a very full account of this important phase of aviation has been given before the Royal Aeronautical Society by Squadron-Leader W. R. D. Acland.

The early history of deck flying is a fascinating one.

The British took the old Cunard liner *Campania* and fitted it with a flying after-deck nearly 250 feet long. Seaplanes were successfully launched from this deck under conditions when it was impractical to take off from the water. An axle and wheels were attached to the underside of the floats and the aircraft was flown off like a land plane. As soon as the machine was in the air, the pilot pulled a quick release which allowed the axle and wheel to drop off. Later the seaplane was placed on a trolley. On reaching the end of the deck the trolley was arrested by two arms fitted with shock absorbers. This was fine for getting off, but it did not solve the problem of the return of the plane. Seaplanes had to alight frequently in rough water, and the process of hauling the craft aboard was always a difficult and perilous one.

Therefore the next attempts were made with land planes. The *Furious*, a British


TOO HIGH
(2) DIVING, RESULTING IN A FAST L...
INABILITY TO DEPRESS THE TAIL WITHOUT BALLOONING
NORMAL
WIND RELATIVE TO SHIP
DISTURBED AIR

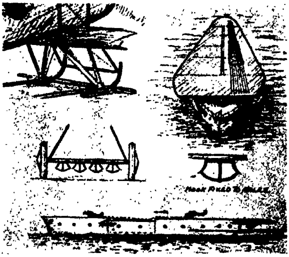
Correct and incorrect methods of landing on an aircraft carrier warship commissioned in 1917, was the first attempt at a floating airdrome; that is, a vessel to which landplanes could return after a flight. The flying deck consisted of the roof of the hangar, extended 200 feet and sloped downward in order to give a clear flow of air over the deck. Squadron Commander Dunning made the first British landing on a ship under way and lost his life in a subsequent attempt. He adopted the following method: The ship steamed head into the wind. This meant that the pilot's speed relative to the deck of the ship was reduced by the speed of the head wind and the speed of the ship itself. A party of officers and men would grab the aircraft as soon as it touched. In the first successful attempt it was actually caught while still in the air. Grabbing hold in the air did not seem practical so on his second attempt Dunning gave orders that the plane was not to be touched till after he was on deck. Arriving on the deck with his engine running, he burst a tire, slewed over the side, and was drowned before help could reach him.

After this unfortunate accident it was decided that some form of arresting gear had to be devised. The first arrangement consisted of a number of fore and aft wires a few inches apart. When landing was in progress the wires were supported five or six inches off the deck by small wooden blocks. Stretched transversely across these wires at about 30-foot intervals were ropes to the ends of which were attached bags of sand. The plan was that the pilot should let down a hook which would pick up successive transverse ropes as the aircraft ran down the deck, thus progressively increasing the drag and stopping the aircraft. "Horns" engaged in the fore-and-aft wires were to keep the aircraft on a straight course.

The arresting gear worked fairly well, but there was a high wastage of equipment and many serious accidents. If the plane had a landing speed of 50 miles per hour, the vessel was steaming at 20 miles per hour, and the head-on wind was 15 miles, the landing speed relative to the vessel was theoretically only 15 miles per hour, and a 200-foot run plus the action of the arresting gear was theoretically more than sufficient. But half way up the deck the natural wind was completely blanketed by the funnel, mast, and bridge, so that the relative wind dropped by 15 miles. This was a serious matter when the aircraft was brought in during bumpy weather at considerably more than the minimum speed of 50 miles per hour. Fortunately for the pilots, a strong rope net was fixed to the forward end of the landing deck so that no plane actually hit the funnel, although many craft made determined efforts to break through the net.

The definite lessons learned were as follows: 1; The aircraft should have a clear run so that if the pilot found he was unlikely to touch the deck until too far along, he could give her the gun, and go round for another attempt: 2; It was easier to approach from right astern in spite of bad bumps than to have to drift round the bridge and land forward: 3; That in spite of many cases of aircraft overshooting, with a clear run no arresting gear was necessary.

With these lessons in mind, came the first flush deck aircraft carrier, the *Argus*. The *Argus* was provided with an additional aid in the form of a lift, or elevator as we call it. For landing, the elevator was lowered some nine inches and a sloping ramp was fitted on the forward end. The aircraft dropped into the well, pushed the hooks on to the wires and was securely held. Subsequently with the extension in length of the gear, about 500 landings were made, of which 40 resulted in complete ruin of the plane, and 90 involved minor damage. On the whole the principle of the aircraft carrier was vindicated, and the next aircraft carrier *Eagle*, assumed the now almost standard appearance.



Above: **H. M. Carrier *Eagle*.** *At left:* **Skid undercarriage with hooks. The sketch in the upper right hand corner shows arrangement of the wires along the deck and over the center lift indicated in the lower diagram. This experiment was carried out in H. M. S. *Argus***

Further experience showed that, however satisfactory the arresting gear was in calm weather, it was in itself a cause of accident in rough weather. Fore and aft wires were discarded, the hooks and other gadgets on the plane disappeared. The modern wheel brakes independently applied on each side not only shortened the landing run appreciably, but also helped to keep the airplane along the center line of the carrier. There were occasions, however, when the airplane still persisted in going overboard. The idea of sloped, protecting palisades was therefore arrived at, constituting a sort of "island" on the deck of the carrier. These palisades consisted of stanchions spaced about eight feet apart with wires strung between them, and they extended for about 150 feet on each side of the deck at its forward end. The palisades sloped up at an angle of about 30 degrees, and effectively prevented the plane from going over the side, so they did restrict the landing space somewhat.

At the present time 99 percent of the deck landings are entirely successful.

One of our diagrams shows what the pilot should and should not do when approaching the aircraft carrier.—*A. K.*

H. M. S. *Furious* with its flying deck

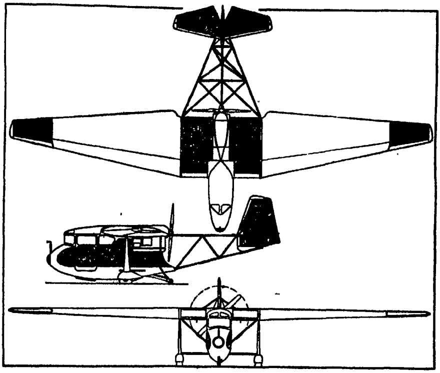
Substitutes for Ammonia Refrigerant

CHEMISTRY is continually penetrating further into the refrigerating industry, and recently attempts have been made to utilize the ammoniates and similar compounds instead of ammonia as refrigerants. According to the experiments of R. Planck and L. Vahl in the Kaltetechnischen Institut der Technischen Hochschule Karlsruhe, calcium chloride ammoniate is especially recommended for this purpose and lithium chloride ammoniate also should be considered.—*A. E. B.*

The Sky Car

MR. WILLIAM B. STOUT, well known aircraft constructor who was originally responsible for the organization of the Airplane Division of The Ford Motor Company announces through the press a new, small, two-seater plane built in the Stout Engine Laboratories.

The "Sky Car" as it is called, is powered with a four cylinder, in-line, air-cooled engine mounted as a "pusher" in the rear of the wing and car. It is interesting to see that American airplane designers are returning to the "pusher" type.



At left: Outline drawing of the all-metal, two-place, light airplane

The arguments in favor of the "pusher" are that there is no propeller at the front end of the machine for anyone to wander into, and that the pilot and passengers can be seated at the very front end of the plane where the visibility is nearly perfect. The noise is reduced to a minimum because both engine and the whirling propeller are behind the occupants; the exhaust gases and fumes of gasoline and oil do not bother the occupants; the efficiency is somewhat higher because the fuselage is no longer in the slipstream of the propeller.

The main arguments against the "pusher" on small planes is that the relatively heavy engine is situated behind the occupants and that this is a source of danger in a bad crash. Some of the best engineers of the day, however, are of the opinion that the engine can be so solidly mounted that it should not break loose even in the worst landing, and if the landing is so bad as to shake the engine loose, the crash would be fatal anyhow!

Mr. Stout's design of a "pusher" is therefore in line with what other designers are thinking today; but he has taken a bold step in building an enclosed cabin for a machine with a horsepower of only 75. This is undoubtedly a step in the right direction. If small planes are to be built for private use, there is every reason why a closed cabin should also be provided. The day when the public demanded in its flying the feel, and incidentally the discomfort, of the open cockpit [illegible] gone and it is gratifying to see a [illegible] build such a small cabin plane.

It will be noted that the tail surfaces are mounted on outriggers with two upper booms going to the rear of the wing and a third, lower, boom attached to the rear end of the nacelle. Such a system of outrigger support for the tail provides ample clearance for the "pusher" propeller, and the thrust line of the propeller need not be high up above the wing (an advantage from the point of view of longitudinal stability and trim). In the Curtiss Junior, a "pusher" propeller is also incorporated, but with a fuselage hollowed out somewhat like a flying boat hull. It is difficult to say which is the neater solution. The outrigger support for the tail surface is acceptable engineering practice and has been particularly in evidence of late in the Sikorsky amphibians.

The "Sky Car" in flight

Besides taking a bold step in providing a closed cabin for the so-called "Aerial Flivver," Mr. Stout has taken a further step in using metal construction throughout the wing. This metal construction is similar to the corrugated metal construction of the large Ford planes. Hitherto, designers have usually fought shy of using all-metal, metal-covered wings for very light planes; wooden wings have been preferred because of weight. If Mr. Stout has succeeded in

Below: View of the new so-called "Flivver of the air" during assembly

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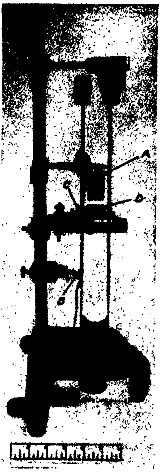


This apparatus is enclosed with a camera which sights on speed course in timing air races. Solenoid A energizes a tuning fork and maintains contact at B. The tuning fork makes alternate contact with points C and D as explained here

building a light, all-metal, cantilever wing for this size of plane, he has again made a step forward.

The tail wheel is not mounted at the end of the outrigger, but at the end of the nacelle. This is a decided structural advantage as the outriggers are thereby relieved of landing shocks. It will also be noted that the tail wheel is somewhat higher than the two front wheels. This is so that the machine may be tilted downwards at its rear to secure a large angle of incidence for the wings either in take-off or in landing.

Besides the few details we have been able to give above and the fact that the wing span is 23 feet, no technical information is yet available. Some of the fittings resemble those found in Ford cars. There is a Ford ignition switch and safety key on the dash and on the floor there is a Ford self-starter button. Another interesting accessory is a brake lever at the left of the pilot's seat which permits one-handed application of the brakes to either wheel for steering or to both wheels for braking. The rudder for directional control is operated by floor pedals similar to those used in the early Ford cars. The price is announced as under 2000 dollars. (The Curtiss Junior, with similar power and n
under 1500 dollars.)

While the plane is very neat in appearance, we are sorry to see the announcement that it is an "aerial counterpart of the famous 'Tin Lizzie,' the Model T Ford" and also that it can be landed in the space of a tennis court. The new machine is not the "Tin Lizzie" of the air since both similar and cheaper planes are available on the market nor does it embody in its design such aerodynamic improvements or novelties as to render its landing qualities very much better than those of similar machines built by other constructors. Anyone purchasing such a craft with the expectation of landing it on a tennis court might be disappointed.

We welcome the arrival of a new, well finished design highly suitable for the private owner; but it does not seem advisable to give the public statements which might raise its hopes of a back-yard flying machine too high.—*A. K.*

Timing at 400 Miles an Hour

THE traditional method of timing an airplane over a speed course is to have observers at each end of the course sighting carefully and timing with synchronized stop watches. The errors are obvious. The observers may make an error in pressing their stop watches; the stop watches may not be correctly synchronized; the observations may be in error by the interval of the stop watch.

Such methods were perfectly satisfactory in the old days when a hundred miles per hour was considered to be high speed, but more accurate methods are necessary to time the Schneider Cup racers as they approach 400 miles per hour. For these races the British have developed a remarkable system of automatic timing.

At each end of the course, a moving-picture camera is sighted on the course. Each camera simultaneously photographs the seaplane as it passes over the course and a Veeder stroke counter which is actuated by the vibrations of a tuning fork. The tuning fork is, of course, the most accurate measure of a time interval in practical use, and is made to vibrate at a frequency of ten per second. The tuning fork makes and breaks an electric circuit which connects the counter at one end of the course to the counter at the other end of the line. Therefore, by subtracting [illegible] reading at one end from the reading at the other when the seaplane is recorded on the film, time is measured correctly [illegible] 1/10th of a second. This is considered sufficiently accurate for speeds of 400 miles per hour. Over a course of two miles, the maximum error in speed measurement would be only about 1/5 mile per hour.—*A. K.*

The Curtiss Junior

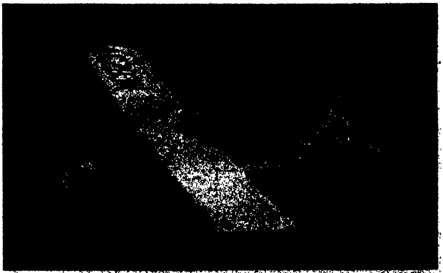
THE Curtiss-Wright Airplane Corporation has brought out a small [illegible]ter, the Curtiss Junior, in a b[illegible]r p[illegible] with the private flyer. The Junior [illegible] place, tandem seated, pusher [illegible] equipped with a Szekely, 40 hors[illegible] three cylinder, radial, [illegible]oled [illegible] Top speed is about 80 m[illegible]er ho[illegible] cruising speed is around 70. Enough [illegible]oline is carried for three hours cru[illegible] Landing speed is claimed as being on[illegible] miles per hour. The weight, empty, is [illegible] 510 pounds, fully loaded, 920 pounds. [illegible] over-all length is 20 feet 10 inches [illegible] span is 39 feet.

The ideal price for a sporting two s[illegible] has always been considered to be $99[illegible]9 or just under a thousand dollars. The Junior does not meet this by several hundred dollars, yet it is a well finished, efficient, sturdy flying machine, with a reasonable top and minimum speed.

The design of the Junior seems to depart somewhat from that of the conventional airplane. The long fuselage has somewhat the appearance of a hull. The cockpit at the extreme forward point of the fuselage gives the pilot and passenger unimpeded vision. The fact that the engine is in the rear removes exhaust, oil, and gas fumes, and minimizes the noise. The likelihood of the engine crashing on top of the occupants is considered negligible by the best authorities. The plane is neither too large for cheap maintenance, nor so small as to be unairworthy. It is decidedly worth while.—*A. K.*

Drug Addiction

THE problem of drug addiction concerns the United States more than any other country. Our per capita use of nar-



The Curtiss Junior, an interesting light airplane. The pilot, at the forward end, has unimpeded vision. The pusher arrangement minimizes fumes and noise cotics, [illegible] to Dr. W. E. Dixon, is 245 [illegible] as compared with 150 for Europe, [illegible] Asia, and 24.5 for Africa. Numerous [illegible] have been made as to the causes of narcotic addiction. The latest figures [illegible] by Dr. W. L. Treadway of the United States Public Health Service indicate [illegible] main causes are previous use of [illegible] in medical treatment, self treatment [illegible] relief of pain, recourse to drugs [illegible] emotional distress, the influence of [illegible] addicts and the indulgence in drugs [illegible] the sake of curiosity, thrill, or bravado.

Among [illegible] addicts in whom the causes for addiction were known, 23 percent were due to [illegible] ous use of drugs in medical treatment, [illegible] percent to self treatment for the relief of pain, and 52 percent to the remaining three causes mentioned. The National Research Council is attempting to solve the problem of narcotic addiction by [illegible] research with a view to finding some synthetic preparation derived from opium which will have all of the qualities of opium and morphine without their tendency to establish drug addiction. The American Medical Association is trying, through its *Journal*, to decrease the amount of narcotics prescribed by physicians by [illegible] the physicians as to the indis[illegible] uses of various narcotics. If physicians will carefully limit their prescriptions to such indispensable uses, the total of narcotics prescribed will be decreased.

A series of studies made by Dr. A. E. Light and his associates in Philadelphia indicate that the addict who has sufficient will power can undergo the withdrawal of morphine safely because the addict can control to a large degree the intensity of the withdrawal symptoms. The Philadelphia investigators are convinced that hysteria plays a large part in determining the intensity of such symptoms.—*M. F.*

Sure-Kill Poison for Troublesome Bushes

A POISON for undesired bushes such as poison ivy and European barberry, quick and sure in its action yet clearing out of the soil after its work is through, was described recently before the meeting of the American Society of Plant Physiologists by Prof. R. B. Harvey of the University of [illegible]

This new agent in man's chemical warfare against tough weeds is ethylene oxide, chemically related to the ethylene chloride which has been found very effective in hastening the ripening of fruits and vegetables. Prof. Harvey discovered the value of ethylene oxide during the course of experiments with various ethylene compounds. He found that the oxide killed the fruits and vegetables instead of speeding up their ripening processes.

He tried the compound on some large barberry bushes, which are being harried out of existence in the great grain areas because they harbor the black stem rust of wheat. What he calls "depth charges" of ethylene oxide dissolved in water were sunk into holes punched in the soil at the roots. A few days later the bushes were revisited, and in every case they were found to be in the last stages of the death struggle. About one and one half ounces of ethylene oxide, diluted to a 10 percent solu-

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tion in water, usually sufficed for a large bush.

At present barberry bushes are fought either by digging them up, which leaves stray roots free to sprout again, or by dumping quantities of common salt into holes at their roots, which is rather hard on the soil. Other chemicals which are effective against them cannot be used because they are poisonous to cattle. "Depth charges" of ethylene oxide, Prof. Harvey concludes, seem to offer the best means so far discovered for killing these and similar noxious plants.—*Science Service.*

When Apples Breathe Carbon Dioxide

SINCE the advent of solid carbon dioxide, or Dry-Ice as a refrigerant, particularly for perishable goods, it has become necessary to determine what effect the carbon dioxide gas, liberated by vaporization, has on the products being preserved. N. C. Thornton, of the New York State College of Agriculture at Cornell University, has recently published, in *Industrial and Engineering Chemistry*, some interesting results of preliminary studies of the effect of carbon dioxide on fruits, vegetables and flowers. Dr. Thornton's work has been carried out at the Boyce Thompson Institute for Plant Research.

Effectiveness of various concentrations of carbon dioxide in retarding bud development and dropping of petals of roses held for seven days at 50 degrees

Although it is not generally realized, most fruits, vegetables, and flowers live and breathe even after they are plucked. Therefore they are known as respiring plant organs. Fruits, except citrus, are more or less affected by forcing them to "breathe" carbon dioxide, according to the concentration of the gas and the firmness and age of the fruit. The noticeable changes in most fruits as a result of exposure to an injurious concentration of carbon dioxide are the development of an abnormal flavor (insipid, bitter, or alcoholic) and a softening or browning of the tissues.

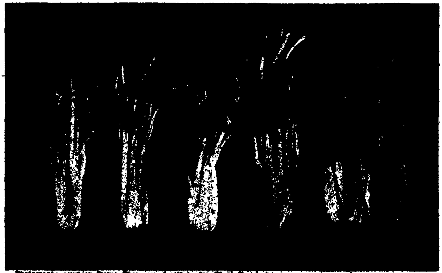
Freshly harvested vegetables vary considerably in response to the carbon dioxide treatment. Celery, lettuce, and spinach stored in carbon dioxide, became soft and took on an abnormal odor.

Flowers seem to like to breathe carbon dioxide. At least, roses, gladioli, snapdragons, and some varieties of carnations]

the gas. The life of rosebuds was prolonged as much as two or three days. Seven days' storage of rosebuds at either 38 or 50 degrees, Fahrenheit, in an atmosphere of 15 percent carbon dioxide produced the best results, although 5 percent was found to be effective. When moved from cold storage into a warm room, the untreated buds opened very quickly, while those which had been stored in carbon dioxide opened slowly with good color and shape.

Dr. Thornton has accumulated accurate data on the tolerance of many different fruits, vegetables, and flowers to carbon dioxide atmospheres. In general, the results show that some plant organs are improved for consumption by proper percentages of carbon dioxide, others have considerable tolerance of the gas, and only a few require that minimal amounts of it be present. These data are being applied to the design of practical refrigerator equipment for the commercial use of solid carbon dioxide. —*A. E. B.*

Apples held for six days in ca[illegible] dioxide at 38 degrees. A and [illegible] controls (untreated); C, 25 pe[illegible] carbon dioxide—no injury or [illegible] normal flavor; and D, 50 per[illegible] of this gas; E, 70 percent; and F, 87 percent, these three showing injury and having abnormal flavor



Photographs courtesy Boyce Thompson Institute for Plant Research

Celery in carbon dioxide for seven days at 50 degrees. A and B are controls; C, 25 percent—no injury; and D, 50; E, 70; and F, 80 percent, all injured

Make Alcohol from Natural Gas

A PROCESS for manufacturing industrial alcohol from natural gas waste is reported to have been developed in the laboratories of the Canadian National Research Council, according to the Department of Commerce. This process is regarded as a means of utilizing the large waste of gas in the Turner Valley oil field of Alberta.

Officers of the research council are now studying the economic possibilities of the process which has been developed. It is stated that the operating cost, excluding overhead and any other charges made for waste as required, would not exceed 25 cents per gallon. Industrial alcohol used annually in Canada at the present time is valued at more than 2,000,000 dollars.

If applied to only the so-called stabilizer gases, the process, it is estimated, could yield industrial alcohol to the extent of 10,000,000 gallons a year.

Dr. A. Cambron, senior chemist at the National Research Laboratories, is reported to have developed a process whereby the waste gas can be converted readily into ethylene, from which alcohol and
chemicals, including glycol, can b
—*A. E. B.*

Chemical Hazards to Photographers

FEW people think of the photographic industry as essentially a chemical industry, but people who spend much of the time in the development and printing of photographs come constantly into contact with a great many poisonous substances, including particularly metol, elon, [illegible] sodium carbonate, [illegible] and cyanides. They are also likely to be affected by manganese. Many of the substances, such as metol and elon, are cresol derivatives which can cause eruptions on the skin and it has been shown that one cresol derivative is responsible for the kind of paralysis that results following the drinking of bootleg Jamaica ginger.

Bud development and dropping of petals of rose at right were retarded by [illegible] percent carbon dioxide for seven days at 50 degrees. The control rose at left dropped petals

The chemical hazards are beginning to be so well understood that it is advisable for all workers with chemical substances to attempt to find out the exact hazard involved before undertaking an extensive exposure to inhalation or skin contact of such chemical substance.—*M. F.*

30,000,000 Volts Are Predicted

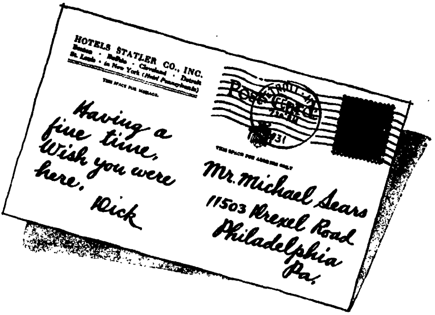
ASPIRATION to duplicate in the laboratory the powerful radiations that hitherto have been produced only by nature, promises to lead to further discoveries by the trio of Carnegie Institution physicists in Washington, whose paper on high-voltage tubes won the 1000-dollar prize of the American Association for the Advancement of Science at Cleveland recently.

Within the realm of possibility of accomplishment in the near future is the production of voltages of 20,000,000 to 30,000,000.

At present the vacuum tubes developed by Dr. M. A. Tuve, Dr. L. R. Hafstad, and Odd Dahl in the laboratories of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington have operated reliably at potentials up to two million volts. This is a remarkable potential to be impressed upon a vacuum tube and it produces the most powerful radiations yet made by man, artificial beta rays, which are high speed electrons, and artificial gamma rays which are very penetrating X rays. Thus two of the three radiations from radium have already been duplicated.

Although Dr. Tuve in delivering the prize paper at Cleveland did not discuss it, he and his associates are now at work on a new method of building up electrical voltages that should soon make it possible to impress upon gigantic X-ray or other vacuum tubes voltages much higher than the five million or so they have generated so far. Thirty million volts are theoretically possible with a modification of what is

(Please turn to page 419)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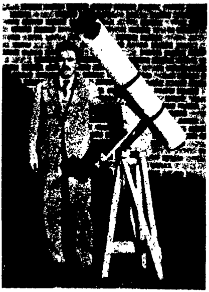
THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

THIS month our department will smack rather strongly of the campus. Professors of all kinds have now taken to making telescopes. The attentive reader may recall the hint in the preface of "Amateur Telescope Making," that it was hoped the professional would do this, thereby qualifying as an amateur in his own right. Four of these "pros" now regain full amateur standing without prejudice. They may shake and quake in unison with the rest of the telescope fraternity.



Professor Corner—anatomist

The first professor is Dr. M. de K. Thompson of the Massachusetts Institute of Technology, an electrochemist in the Department of Physics. Here is what he writes:

"According to the invitation contained in 'Amateur Telescope Making' to those who have made a telescope, I enclose a photograph of one I have just finished.

"The mirror is a six-inch disk of Pyrex glass, one half inch thick. These cost only 95 cents each. The time required for roughing out was six hours and 40 minutes, showing that Pyrex is about twice as hard as plate glass. Fine grinding took three hours and ten minutes.

"After a total of four hours' polishing I found that the edge was turned up, with a high region in the center and a ring around this region. A six-inch stroke brought this to a sphere in one hour, and I parabolized in 20 minutes more with an overhang stroke. The shadows looked exactly like those shown on page 225 of 'Amateur Telescope [illegible] the edge.

"I had great difficulty in cleaning the glass properly for silvering. Scrubbing with cotton tied to a glass rod and wet with nitric acid did not at first leave the surface so that water drained evenly without separating into drops. This is the usual test for clean glass. Then hot caustic followed by hot chromic acid was tried. Neither produced the desired result. Finally, I got a pair of rubber gloves and rubbed with cotton and nitric acid until the surface drained evenly. Over half an hour's vigorous rubbing was required. The silvering then was successful.

"I had a wooden equatorial mounting made as described in 'Amateur Telescope Making,' and made a tripod. This is a 15-pound iron casting drilled to take a one-inch steel pipe, and three half-inch steel rods as feet. As a finder, which is quite necessary, I use a strip of brass with a V-notch at each end. The notches are painted with luminous paint. The ends of the rod are bent up so that any object in line with the bottom of the notches is in the field. I find a piece of silvered windshield, tested for flatness and ground to an ellipse by sticking on the end of a wooden rod one inch in diameter and sawed off at 45 degrees, very good as a diagonal.

"I have been using a Ramsden eye-piece of one-inch equivalent focal length from a microscope, and have had fine results looking at the moon."

Pyrex is made by the Corning Glass Works, Corning, New York. We are glad Professor Thompson rubs in well the necessity of cleaning the glass thoroughly before silvering. The criterion of "clean enough" which a male worker usually applies to dish washing (if he ever does any) won't do at all. This has been emphasized in numerous places but confirmation from outside has added weight.

A PROFESSOR of anatomy, George W. Corner, M.D., of Rochester University, Rochester, N. Y. writes as follows:

"In accordance with your request that persons who have made telescopes under the influence of SCIENTIFIC AMERICAN should send in pictures of the instrument, I enclose a photograph of a six-inch reflector which I constructed. The work was guided entirely by your book, 'Amateur Telescope Making.'

"I have been able to see two or three of the zones across the disk of Jupiter, the ninth magnitude companion of Polaris, and other objects, which makes me feel that the result is up to the average. As you can see, there is nothing remarkable about the instrument. The axes were made from two front hubs of a model T Ford. The total cost was about 30 dollars, exclusive of eye-pieces. I have used microscope eye-pieces from my laboratory for the lower powers with complete success.

"I succeeded perfectly with the silvering [illegible] a that Brashear's method is quite similar to the Bielschowsky method of staining connective tissue reticulum, a technique with which I am quite familiar. It might help those who have difficulty with silvering if it were insisted, even more than in the book, that the critical point is that at which the brown precipitate of alkaline silver [illegible]ared by the addition of more ammon[illegible] care at this point is the secret of s[illegible]

Professor Corner's comment [illegible] the similarity of silvering and staining [illegible]tive tissue reticulum reminds us of [illegible] experience at the dentist's. We dis[illegible] dentist silvering one of our mo[illegible] turned out, this is a well-known [illegible]cedure for plugging u[illegible] minute [illegible]

FROM Ypsilanti, Michigan, com[illegible] ter written by F. R. Gorton, [illegible] of physics and astronomy. No in[illegible]tion was named, but presumably it is the [illegible]chigan State Normal College, which [illegible] at Ypsilanti. Dr. Gorton says the tele[illegible] he describes was produced in connection with college work and, he adds, "I believe that the interest developed in the making of this mirror turned one of our best students to the field of astronomy. He has now completed his work for the master's degree in our state university and receives a scholarship for continuing work in the astronomical field.

"The photograph shows an eight-inch reflector which was made at a very low cost. The instrument is portable, and the eyepiece is easily reached while the observer stands on the ground. The mirror was ground in the usual manner from an eight-inch disk, and the polishing was carried over a long period to remove a few defects from the surface. The definition is very good.

Professor Thompson—electrochemist

"The sheet-metal tube and mirror cell were made of galvanized iron by a tinsmith. The cell is held securely b[illegible] of three screws which serve to bring the axis of the mirror coincident with that of the tube with considerable precision. Around the tube are two bands of strap iron which attach it firmly to a piece of hardwood hollowed on one side to fit the tube. The diagonal is a prism which is provided with a [illegible]ng screw for adjustm

"The pier is made of concrete into which was set at the proper angle a piece of 1¼-inch pipe to receive the polar axis. It is also provided with two holes through which pieces of one-inch pipe are placed for carrying handles. The pier weighs over 200 pounds and was cast on a two-inch base of wood to protect the concrete. The mountings of the telescope are entirely of pipe and pipe fittings."

With a base of the kind Professor Gorton describes it should be possible even to adjust a telescope accurately in the meridian, using a small pinch bar or pry and expect it to stay put if left out-of-doors, yet not have to attach it. This kind of base might well be adapted to flat roofs. The two holes are ingenious, permitting a pair of "pall bearers" to pick up even a heavy telescope without difficulty and walk off with it.

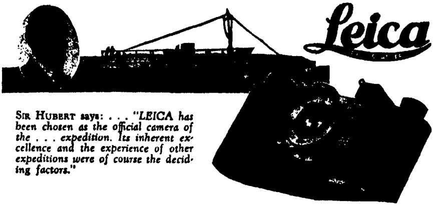
Professor Gorton's telescope

W. A. CALDER of Beaver Dam, Wisconsin, graduated at the University of Wisconsin and took his M. A. degree in physics, but became exposed to telescope making, and now see what has happened: the world has lost a potential physicist, but Mr. Calder i now at Harvard College Observatory (Cambridge, Massachusetts) doing graduate work in astronomy.

"The snapshots," he writes, "show my 'Unfinished Symphony' of telescopes. The little draw telescope started the ball rolling when I was in the grades. I made an equatorial mounting for it, using an old water motor for the polar axis, and peanut butter jar covers for graduated circles. The three-and-a-half-inch Gaertner refractor was bought from the college I attended, through the help of a very kind-hearted professor. It has a fine clock and has made me partial to refractors.

"I made the six-inch mirror last winter according to 'A. T. M.', but not according to Ellison who insists on a cellar workshop or one whose temperature it not subject to rapid variations. It was made in a clothes closet so small that there was barely room to walk around the barrel. Galileo

(Please turn to page 425)



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CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Proximate Composition of Fresh Vegetables (Circular 146-C, U. S. Department of Agriculture) gives tables including 121 varieties and classes of vegetables. *Office of Information, U. S. Department of Agriculture, Washington, D. C.—Gratis.*

Manufacture of Insulating Board from Cornstalks (Miscellaneous Publication No. 112, Bureau of Standards, U. S. Department of Commerce) by O. R. Sweeney and W. E. Emley gives full information on an industry which bids fair to become of great economical importance. *Superintendent of Documents, Washington, D. C. 10 cents (coin).*

Airworthiness Requirements of Air Commerce Regulations for Aircraft (Aeronautics Bulletin No. 7-A). *Aeronautic Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

Bibliochresis: The Pilot of Research (Reprinted from *Science*, April 11, 1930) by William A. Hamor and Lawrence W. Bass. Bibliochresis, the scientific use of literature, has the pilotage of all scientific investigation. *Mellon Institute of Technical Research, Pittsburgh, Pa.—Gratis.*

The Inside Story of Ethyl Gasoline tells why ethyl gasoline gives the best performance of the newer cars with engines of higher compression. *Ethyl Gasoline Corporation, Chrysler Building, New York City.—Gratis.*

Bibliography of Aeronautics for 1929 covers the aeronautical literature published from January 1 to December 31, 1929. It contains 242 pages. *Superintendent of Documents, Washington, D. C.—35 cents (money order).*

[illegible]e Actions and Reactions (School Service Series Number Five, American Museum of Natural History) by William H. Carr, deals with the nature trails and trailside museum at Bear Mountain, N. Y., and is the fifth in a series of excellent handbooks, all copiously illustrated. *American Museum of Natural History, 77th Street and Central Park West, New York City.—20 cents.*

National Metals Handbook gives a wealth of material, published by the American Society for Steel Testing. It is a bound volume brought out in revised and enlarged form approximately every two years and it is kept up to date by loose leaves. A full prospectus is sent on request. *American Society for Steel Treating, 7016 Euclid Ave., Cleveland, Ohio.—Free to members. To non-members, $10.00.*

Arc Welding Supplies, a trade publication, gives useful information as to welding supplies. *The Lincoln Electric Co., Cleveland, Ohio.—Gratis.*

Educational Directory 1931—Part I.—Elementary and Secondary School Systems (Bulletin, 1931, No. 1, Office of Education, U. S. Department of the Interior) gives a valuable list of educators all over the country including parochial schools.—*Superintendent of Documents, Washington, D. C. 15 cents (coin or money order).*

Industrial Research, Beneficent Arbiter of Modern Progress (Reprinted from *Chemical and Metallurgical Engineering*, Jan. 1931) by William A. Hamor, describes the place of the Mellon Institute in research. *Mellon Institute of Industrial Research, Pittsburgh, Pa.—Gratis.*

The Chemical Control of Closed Circulation Systems of Sea Water in Aquaria for Tropical Marine Fishes (Zoologica Vol. IX, No. 11) by C. M. Breder and T. H. Howley of the New York Aquarium. If your hobby is marine tropical aquariums you and your fishes need this booklet. *New York Zoological Society, The Zoological Park, New York. Price—35 cents.*

The Engineering Features of "Built-In" Lighting (Reprint from *Lighting*, November-December 1930; January 1931) by A. L. Powell and Alston Rogers, who consider that "built-in" lighting must be designed as a component part of the building, the sort which in general cannot be applied to a structure that is entirely furnished. It is profusely illustrated. *Nela Park Engineering Dept., General Electric Co., Cleveland, Ohio.—Gratis.*

The Distribution and the Mec Properties of Alaska Woods (Technical Bulletin No. 226, United States Department of Agriculture) by L. J. Markwardt fills a much needed niche in the literature of forestry, for there was a lack of reliable information concerning the extent and properties of the woods of Alaska. *Office of Information, U. S. Department of Agriculture, Washington, D. C.—Gratis.*

Annotated Index of Theses and Dissertations in Education has been compiled by Professor F. J. Weersing and B. R. Haynes and the purpose of the index is to provide a guide to the formal research which has been made by students of Education at the University of Southern California. *Associated Students' Store, University of Southern California, Los Angeles, Cal.—75 cents.*

Disston Saw, Tool and File Manual describes the use of many tools and is profusely illustrated with well [illegible] pictures. *Henry Disston & Sons, Inc., Philadelphia, Pa.—Gratis.*

The Search for Raw Materials—The Romance of Business and the Leavening of Commerce is an interesting paper on the subjects indicated in the title. *William M. Booth, 925 University Building, Syracuse, N. Y.*

Annual Report of .... Director to the Board of Trustees for the Year 1930 (Publication 287, Report Series, Vol. VIII, No. 2, Field Museum of Natural History) gives the story of the year in [illegible] of 522 pages. It is well illustrated. *Field Museum of Natural History, Chicago, [illegible]—$1.00, postage extra.*

Bibliography of North American Geology 1919-1928 (U. S. Geological Survey Bulletin 823). The latest volume ([illegible]05 pages) of a standard key to periodical geological literature, much used by the research worker. *Superintendent of Documents, Washington, D. C.—$1.25 (money order).*

Habits and Economic Status of the Pocket Gophers (Technical Bulletin, No. 224, United States Department of Agriculture) by Theo. H. Scheffer describes this burrowing rodent which is an agricultural pest, for the animals are great eaters of roots and tubers. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

Armco "Metalcurb" describes the latest contribution to scientific highway construction. It is adapted for bituminous and brick pavements. *The American Rolling Mill Company, Middleton, Ohio.—Gratis.*

United States Earthquakes 1928 (Serial No. 483, Coast and Geodetic Survey) gives a list of quakes in U. S. in 1928. It is an extension of the well known publication entitled "Earthquake History of the United States." *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

How To Judge a House (Report of the sub-committee on How to Judge a House of the National Committee on Wood Utilization) by Nelson S. Perkins, C. E., is a pamphlet which should be in the hands of anyone who is thinking of building or buying and may prevent buying unwisely. The elements of value are carefully explained. The pamphlet is of extraordinary value. There are 41 illustrations. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 415)

called the Faraday cage which has been developed.

By using these voltages to accelerate the positively charged cores of hydrogen atoms these scientists will have by far the most powerful projectiles ever available to a human being, resembling the alpha rays from radium. What will happen when they are let loose is still a matter of discussion among scientists.

Some physicists have suggested in the past that if such powerful radiations were allowed to smash into the hearts of atoms, there might be a liberation of the immense internal energy of the atoms with a gigantic explosion that would wipe out the world and this corner of the universe. This idea was the theme of the Broadway success of several years ago, "Wings Over Europe" in which a scientist, not unlike the Dr. Tuve of real life, solved the secret of physics and held the fate of the nations and the world in his grasp.

But most physicists do not expect such a cataclysm. They expect the artificial radiations to be extremely useful in probing deeper the fundamental structure of matter. They expect as a by-product that the powerful radiations will be useful in the treatment of cancer and possibly put to other medical uses. They expect that the radiations will give new knowledge of the earth's magnetism and how it is caused. This latter possibility was the starting point of the whole investigation and is the reason for its support by the Department of Terrestrial Magnetism of the Carnegie Institution, directed by John A. Fleming. Incidentally, there will also come a better understanding of radio because physicists feel sure that the radio-reflecting Kennelly-Heaviside layer above the earth is affected by natural radiations that come from the sun and outer space.

Dr. John C. Merriam, president of the Carnegie Institution, expressed delight at the award of the American Association prize to the three members of his institution and explained: "Their work represents a long continued intensive study of this problem and it is a great pleasure to know of the recognition of the work at this stage of the investigations."—*Science Service.*

Tonsils and Adenoids

ONE of the most interesting medical experiments in recent years has been the careful observations of the lives of 2200 children whose tonsils and adenoids were removed ten years ago as compared with 2200 children whose tonsils and adenoids were not removed and who have also been observed for ten years with relationship to various diseases. Such an investigation has been made by Dr. A. D. Kaiser of Rochester, New York. In his report, read at the Second International Pediatric Congress in Stockholm, Dr. Kaiser drew the following conclusions:

The removal of tonsils and adenoids influences favorably the incidence of the following infections:

(1) Colds in the Head: These occur in

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"And would it not be proud romance
Falling in some obscure advance,
To rise, a poppy field of France?"

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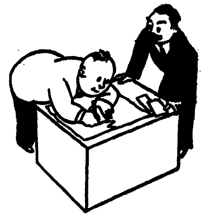

When a hotel manager *made a road map*

THIS guest was leaving early in the morning for the South. And he didn't know the road. During the evening, the manager himself made a road map for the guest. Did the guest appreciate it? He wrote back and said he never made a wrong turn.

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SHREVEPORT, LA.	The Washington-Youree
NEW ORLEANS, LA.	The Roosevelt
NEW ORLEANS, LA.	The Bienville
TORONTO, ONT.	The King Edward
NIAGARA FALLS, ONT.	The Clifton
WINDSOR, ONT.	The Prince Edward
KINGSTON, JAMAICA, B.W.I.	The Constant Spring

22 percent of the tonsillectomized children and in 31 percent of those used as controls.

(2) Sore throats: These occurred in 10 percent of the tonsillectomized children and in 35 percent of those used as controls.

(3) Cervical adenitis: This condition occurred in 7 percent of the tonsillectomized children and in 14 percent of those used as controls.

(4) Otitis media: This condition occurred somewhat less frequently in the children operated on. In these children, over a period of ten years, there was a decreased incidence of 10 percent, while in the children used as controls there was a decrease of 6 percent over the same period.

(5) Rheumatic disease: The first attack of rheumatic fever and rheumatic heart disease occurred 33 percent less commonly in tonsillectomized children. Chorea and recurrent attacks of rheumatic fever were not influenced by removal of the tonsils.

(6) Diphtheria: This disease occurred in 1.3 percent of the tonsillectomized children and in 1.9 percent of those used as controls.

(7) Scarlet fever: This disease occurred in 3.3 percent of the tonsillectomized children and in 4.6 percent of those used as controls.

(8) Nephritis: This condition occurred only one third as often in the children whose tonsils had been removed.

(9) Dental infections: Such infections occurred only half as often in the children whose tonsils and adenoids had been removed.

The following infections were influenced favorably, to a slight degree, or not at all:

(1) Chorea: This condition occurred with somewhat greater frequency in the children whose tonsils and adenoids had been removed, but the cases of chorea developing in tonsillectomized children showed a lower incidence of carditis.

(2) Measles: This infection occurred with equal frequency whether the tonsils had or had not been removed.

(3) Laryngitis: This condition developed in 5 percent of the children in both groups over a ten-year period.

(4) Tuberculosis: This condition occurred with equal frequency, as judged by the tuberculin test in both groups of children.

(5) Malnutrition: Malnutrition occurred in nearly as many children whose tonsils and adenoids had been removed as in those who had not undergone operation.

The removal of the tonsils and adenoids influenced unfavorably the incidence of the following infections:

(1) Bronchitis: This condition occurred somewhat more frequently in the children whose tonsils had been removed.

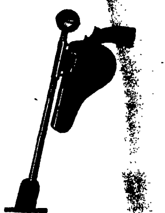
(2) Pneumonia: This disease occurred more frequently in the children whose tonsils and adenoids had been removed.

(3) Sinusitis: First attacks of sinusitis occurred somewhat more commonly in the children whose tonsils and adenoids had been removed.—*M. F.*

Pistol Holder For Automobiles

REMINISCENT of the ready-to-hand mounting of machine guns in airplanes, a new device for holding a pistol holster on the gear-shift lever of an automobile provides for greater protection than does a belt or shoulder holster. Its use injects an element of surprise into the defense of a car that is suddenly waylaid by thieves since the movement of the driver's hand to the shift lever would pass unnoticed. Instead of shifting the gears into neutral, however, the driver [illegible] his pistol, the handle of which is directly beside the lever knob.

The new Holster Holder, which is now being patented by a former army officer, consists of three small but strong pieces of stamped metal, two of which are permanently attached to any leather holster. The third piece slips over and is clamped to the gear shift rod. A wide fin on this part slips tightly into a slot on the holster attachment, and may be inserted or removed at will. When used by anyone intrusted with the transportation of valuables, merchandise, or money, it may be detached and carried on the person when leaving the car.



A handy revolver holster that slips to the gear-shift lever of a car

This same device may be used in banks, paymasters' cages, or other places where there is danger of hold-ups. In such use, it would be attached to a rod on a flange base screwed to the woodwork. The supporting rod may be bent or curved to place the pistol in an easily accessible position.

Munchausen Outdone By Scientists Who Freeze Light

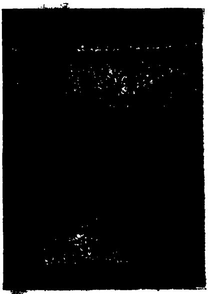
BARON MUNCHAUSEN, reputed the world's biggest liar, told a big one when he described his trip into the far north where it was so cold that the ring of a bell was frozen and the frozen sound brought back to be thawed out. However, today's scientists are actually able to go him one better by "freezing" light. One of the effects that the cathode-ray tube produces is to cause some substances to become brightly fluorescent, or to give off light even after the raying has been stopped. Different colors of light are produced by different substances, and different colors are also produced by a substance at different temperatures.

At a recent demonstration by General Electric Company research engineers, a strip of fluorescent screen material was subjected to a cathode-ray bombardment in the Schenectady laboratory. The material was then placed in a vacuum bottle containing liquid air, and in that condition carried to New York. When the screen was removed from the liquid air at the meeting, it could not be seen in the darkened room. But as it warmed up, it began to glow with a deep yellow tint. It became warmer, and the glow became purple. As it continued to warm up to room temperature it continued to glow in different hues, with waves of colors sweeping across the small screen in much the same way as the Northern Lights sweep across the sky on cold nights. Baron Munchausen has been outdone.—*A. E. B.*

New Bearing Material is Real Metal "Sponge"

A SELF-OILING, bearing *material* that will eliminate squeaks and excessive wear, and minimize friction, has been found by Chrysler Motors engineers. It has been appropriately christened "Oilite" because of its properties.

"Oilite" is an alloy of copper, tin, and other metals. It is subjected to tremendous pressure, heat treated, and then impregnated with hot oil in a vacuum. It absorbs up to 40 per cent of oil by volume. Its high oil content may be proved by any one of numerous tests. If squeezed in a vise, it drips oil. If subjected to a slight pressure when filled with water, oil is forced out. Even so slight a rise in temperature as occurs when it is left to stand in the sun will cause oil to seep out.



Photomicrograph of the oil-absorbing sponge metal used for bearings

"Oilite" has a strength much greater than that of ordinary "self-oiling" bearing materials. This great strength averts the delays and expense of breakage in assembly. Due to its high oil content, a hydraulic cushion exists that permits bearing loads in excess of those carried by conventional bearing materials. The development, therefore, not only accomplishes a satisfactory self-oiling bearing, but also one superior to high-grade cast bronze, for applications where severe duty and high pressures are encountered.

"Oilite" imparts a high polish to shafts, instead of scoring or tearing them. New manufacturing processes are employed that assure a higher standard of accuracy than heretofore available in commercial bearings. This accuracy insures a greater percentage of bearing surface on the shaft.

One of the most important uses of "Oilite" is in spring shackles. The secret of perfect lubrication of these shackles is to keep oil in and dirt out. As used on many of the cars built by Chrysler Motors, the upper fitting is of rubber and the lower of "Oilite," making the car ride on oil and rubber, a perfect combination for ease and long life. A packing ring protects the shackle bearing from water and foreign matter. A lubrication fitting may be supplied on the bolt but experience has established that it is seldom necessary to refill during the ordinary life of a car.

An excellent application is on the steering gear cross shaft. Here high pressures and severe shock loads cause many bearing failures. "Oilite," however, due to the cushioning effect of its high oil content, and its unique qualities as a bearing, has proved a perfect material for this duty.

"Oilite" has passed the experimental stage. It has proved its worth in many thousands of Chrysler-built passenger cars and trucks. It stands up longer than any other bearing material, causes virtually no trouble and raises performance standards.

This material is used in the spring shackles, the front and rear water pump bearings, the clutch pilot bearing, steering gears, and other positions on Chrysler, Dodge, De Soto, and Plymouth cars, produced by the corporation. It is handled commercially by the Amplex Manufacturing Company of 7900 Joseph Campau Avenue, Detroit, a division of the Chrysler Corporation.

Mothballs Keep Mosquitoes from Descending Chimney

MALARIA-BEARING mosquitoes emulate Santa Claus in some parts of the South. When they find doors and windows screened, they come down the chimney seeking whom they may devour, and bearing unwelcome gifts of "fever 'n' ague." But you can keep them out by hanging a little basket of naphthalene, the stuff mothballs are made of, at the top of the chimney. They hate it, and will zoom out of its range as soon as they smell it, no matter how much good biting may lie slumbering below. This is one of the curious facts about mosquito behavior which have been learned by the United States Public Health Service.

Not all mosquitoes will enter houses by coming down chimneys, and it is not known whether all of them can be driven off with naphthalene. One species, however, responds in this way, *Anopheles quadrimaculatus*, the four-spotted malaria mosquito. But she is important enough to make this bit of entomological knowledge very much worth having.—*Science Service.*

"Boundary" Rays Reveal Counterfeits

IN these days when X rays are being used to look inside of golf balls and steel castings and when ultra-violet rays are being used to cure rickets and to improve the quality of everything from butter to cigarettes, it is hard to keep abreast of all the new applications of rays. Now, the situation is still further complicated by the discovery by German chemists that the so-called Bucky boundary rays which lie in the spectrum between the ultra-violet and

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Above: Pump and comparing chamber for determining the amount of sludge in engine oil. *Right:* The installation being used

◆

The Oil Change Problem

THE proper time to change the oil in the crankcase has been a puzzling and vexatious problem to many motorists and maintenance engineers, who thoughtfully consider proper and economical lubrication for their engines.

It has been customary in most instances to discard the oil in the crankcase after the speedometer shows a definite mileage covered or at regular periodic intervals. This practice seemed justifiable, since it was impractical for most motorists to have their oil tested by a chemist or laboratory. This procedure is, however, quite contrary to the most modern scientific knowledge of engine wear and proper economical lubrication.

Modern information proves that oil itself never wears out. In fact, it has been very definitely shown by the Bureau of Standards that after oil has been used for a few hundred miles, it is better oil, in most instances, than can be bought. A clean used oil will cause less wear than an absolutely new oil. (S.A.E. Dec. 1930.) This is due to the super-refining in the engine. The contaminants which cannot be removed at the refinery, and the various bleaching agents, and so on, used to make the product more marketable, and the more readily oxidizable unsaturated hydrocarbons have been removed. This is accomplished by the physical and chemical activity in the engine with the available supply of oxygen.

It is therefore obvious that under the present system of judging the time to change oil by means of the calendar or the speedometer, there will be times when the motorist is throwing [illegible] oil which has been so super-refined by the engine that it is better oil than can be bought.

The S & S Research Laboratory started work a few years ago upon the belief that when the sludge begins to accumulate in appreciable quantities, the colloidal carbon particles and the larger conglomeration of dust, metal, and carbon are the factors determining the color of the oil by transmitted light since all these particles are opaque and will therefore tend to darken the film. The principal color would therefore be an indication of the sludge content. This made it necessary to determine the relationship between the change of color of an oil and the percentage of sludge which it contained.

It was found that, by using the device shown in our accompanying illustrations, there is a direct correlation between the color of an oil, after use, and the percentage of sludge it contains.

After careful measurements and testing, it was determined that if the oil would be exposed to the tester in a film $\frac{1}{32}$ of an inch in thickness, with the proper illumination behind it, then this film by transmitted light would appear black if it contained excessive sludge. The device pictured herewith was the outgrowth of this conclusion.

With this instrument, a sample of oil is picked up right from the crankcase by means of a simple suction pump. It is exposed to the tester in a test tube, the walls of which are $\frac{1}{32}$ of an inch apart. A light from behind, of the proper intensity, illuminates this film. The oil will then be seen by transmitted light, and as noted before, this will indicate the sludge content of the oil. The condition of the lubricant is immediately obvious at the first trial. Its *color is an accurate indication of its condition.* If the oil is any shade of brown, it is still good, and should be used regardless of the mileage or time it has served. If, however, the oil is black, it is a warning to change or it will cause excessive wear. The entire test takes but a moment. A slight pull on the pump—the oil comes up, one glance and you know—no guess work. The whole problem has been carefully worked out and simplified. In order to facilitate the judgment as to the color of the oil, a small rectangle of glass matched to the color of an oil which is just turning bad, is inserted right next to the test tube. This increases accuracy and helps judgment. A second test tube, of the same dimensions as the first is just to the side of it. In this tube is placed a pure sample of oil. By means of this comparison, the tester may keep before him a gage of new oil, bad oil, and the oil he is using.

Garagemen, operators of fleets of trucks or buses and many others have adopted this device for constant use.

CLEMENCEAU AND FOCH

By Captain W. D. Puleston

(Continued from page 400)

Foch believed that "only the advantages gained by the Armistice would be permanent"; he wanted to establish a buffer Rhineland state between France and Germany, and he wanted to include among the provisions of the Armisti [illegible] would facilitate the creation of this state.

Foch also suggested that the French Foreign Office should detail an attaché to keep in close contact with him, so that he would be kept "fully enlightened on all necessary points. For [illegible] ice, from political and diplomatic aspects as well as from the military point of view, bears in it the seeds of the [illegible] ce."

Clemenceau interpreted this suggestion as a request to "assign to Foch an official from the Quai d'Orsay to enable him [illegible] discuss the question of peace direct with the Germans." He regarded the communication as "an invitation to relinquish in Foch's favor the authority vested in his office"; and professed to believe that Foch wanted to reduce the statesman's role "to communicating to the Allies the decisions of the soldiers put into proper terms by a diplomat subordinate to him."

Clemenceau *misjudged the motives of* Foch, who was sincerely convinced that France needed both security from Germany in the future and reparations for the ravages of the World War; Foch steadily refused to consider those two essentials separately. During the Peace Conference he pointed out that England had insisted upon: The removal of the menace of the German fleet; possession of captured German colonies; and acquisition of a large amount of German merchant marine, and had obtained her demands at once. France's part in the war was no less worthy than England's and he felt France should be no whit less insistent upon her demands than England.

Foch said that if Clemenceau had employed him oftener in the negotiations with the Allied statesmen, they would have listened to him because he was the Allied Commander-in-Chief, and that he could have convinced them that the security of Western Europe, as well as France, depended upon France holding the line of the Rhine. As a last appeal, Foch suggested that Clemenceau could say to the Allied chiefs that the French people agreed with Foch's views and the French Government must sustain these views. If the Allies were persuaded to insist upon these terms, Foch guaranteed that he could impose them upon the Germans.

In the military situation existing during the Peace Conference, Foch could have imposed any terms upon Germany. But his ardent temper caused him to overestimate his influence upon the Allied [illegible] He knew that the Allies had been held together only by the German menace; that once it was removed, they would pursue their own national interests; and he realized as well as Clemenceau, that the British Government was even then intent on restoring the balance of power on the European continent.

Clemenceau appraised the Allied statesmen more precisely than Foch. In his innermost soul the old Vendean probably longed for the Rhine boundary as eagerly as Foch, but he quite accurately emphasized to Martet "that if the treaty was not so grand neither was the war so grand. It took four years . . . and many nations to bring Germany to her knees." Clemenceau knew that all the other Allied nations, except Belgium, were quite unwilling to extend the French frontier and perhaps create another Alsace-Lorraine; and every one [illegible]

extend French boundaries. President Wilson said, "The question of frontiers is no business of soldiers." On Armistice Day Lloyd George was already seeking a formula to re-establish the balance of power.

FOCH could be satisfied with nothing less than confining the Germans to the *east bank of the Rhine, with a buffer* [illegible]

Britain nor the United States would support these French claims. In lieu of security by a strong frontier, Wilson and Lloyd George promised Clemenceau security by a treaty that pledged both Great Britain and the United States to come to France's help if attacked by Germany.

Foch had no confidence in these treaties, remonstrated orally and in writing with Clemenceau, and, when Clemenceau was unmoved, insisted upon appearing in person before the Allied chiefs in his capacity as Commander-in-Chief of the Allied Army.

Before this Foch had hinted that as Commander-in-Chief of the Allied Army he was not responsible to Clemenceau but to the Allied Governments and was partly sustained in this position by Poincaré. This claim was indignantly denied by Clemenceau; however, he permitted Foch to present his views to the Allied Premiers, who listened attentively to Foch's carefully prepared statement but were entirely unmoved. So determined was Foch that, when he failed to convince the Big Four, he insisted upon appearing before the entire French Cabinet to restate his views, and to warn them that, having finally won a desperate war, they were throwing away the fruits of victory and compromising the future safety of France. Poincaré certainly and many of the French cabinet probably sympathized with Foch, but were bound to agree that Clemenceau had obtained as much for France as was possible under the circumstances and probably more than any other Frenchman could have obtained.

Foch still believed that if Clemenceau had made more use of his prestige and position as the Allied Commander-in-Chief,

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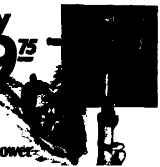

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the Allied statesmen would have made a larger effort on behalf of France. But Clemenceau knew that England would not make France the overlord of the continent, that Italy was only intent on her own future, and he vaguely dreaded the idealism of President Wilson more than the well-known national motives that he knew actuated European rulers which he could readily predict and guard against.

These foreign statesmen were overwilling to pin medals on Foch and to acclaim him as the greatest soldier since Napoleon, but they were unprepared to accept his proposals regarding the peace terms, and had they done so they probably would not have been supported by their own states. Unquestionably Clemenceau was nearer correct than Foch in what was attainable at the peace conference.

On this rock the failing friendship between the two gallant Frenchmen, who together had saved France, finally foundered, and though for a while certain outward forms were preserved, it was well known in France that the two great war chieftains were no longer comrades. Eager partisans widened the breach during the few years left to these tired giants, and embryonic biographers sought future fame for themselves as well as their subjects by preserving, perhaps exaggerating, every difference of opinion until each bitter thought was barely uttered before recorded.

THE death of Foch released his intimate conversations with Recouly that contained severe strictures on Clemenceau, who deferred his preparations for the grave long enough to counter-attack his old colleague with the same youthful vigor that formerly terrified the Chamber of Deputies.

Biographies of great men have a continuing fascination for most people. It is the form of literature that continually inspires the ambitious to attempt to escape from present obscurity and future oblivion. The generation of the war, eagerly waiting to read of Foch's activities, could not avoid hearing the criticisms that he, descending into his tomb, hurled at Clemenceau.

While distant admirers of Clemenceau might hope he would disdain to answer Foch, none acquainted with his savage spirit expected him to fail to return the blows with usury. The priest-like Foch and the philosophizing Clemenceau were both too ardent to refrain from one last bout as the curtain of life descended. They were animated by passionate convictions and while this fight between former colleagues, carried on by one in grave clothes and the other in his dressing sack, has some very unedifying features, they would have been untrue to type if they had stifled their beliefs to insure a peaceful earthly exit.

They both had labored for France from their youth; they both were conscious of their own ability with no false modesty, the statesman was sustained by a fanatical devotion to certain political principles, the soldier by the enviable faith that his ancient religion inspires in its devout believers. Neither disdained popular applause, but both looked to their inner consciousness for their real rewards, and yet neither could bear to depart this world until he had laid before future Frenchmen the reasons for his conduct in the critical days of the war and the first trying days of peace. Living, they strove valiantly for France; dying, they yearned for her approval. Surely France can be proud of her two sons who could not bear to die and then perhaps suffer her displeasure; probably only France could raise such an unlike couple and unite them by a fiery courage and a burning love for country. Future generations of Frenchmen should struggle to be worthy of them. In a sense they both deny their country's desire for strong frontiers, for if French civilization continues to produce Clemenceaus and Fochs, France needs no other guarantees for her security.

●

The books listed below are available for those who desire to peruse in more detail the lives of the two fearless Frenchmen on which the foregoing articles were based.

"Foch" by Maj. Gen'l. Sir George C. Aston, K. C. B. The English viewpoint.

"Life of Marshal Foch" by Capt. B. H. Liddell Hart.

"My Conversations with Foch" by Raymond Recouly.

"Grandeur and Misery of Victory" by Georges Clemenceau.

"In the Evening of My Thought" by Georges Clemenceau.

"Georges Clemenceau" by Jean Martet, his secretary and personal friend.

"The Tiger: Georges Clemenceau" by George J. Adam.

DIESEL VERSUS GASOLINE-ENGINED PLANE

(Continued from page 401)

Both engines, of course, must have oxygen for the burning of their fuel. The advantage held by the Diesel engine enters at this point for the Diesel engine starts out at ground level with a great excess of oxygen beyond that which is needed to burn the fuel.

This excess in the Packard Diesel engine apparently was maintained in the test until after the plane had passed the 8000 foot level, for there was a steady increase in speed of the plane and the speed of the propeller, due to the lessened resistance as the air grew rarer, up to and including the altitude of 8000 feet.

Neither of the two engines in the tests was equipped with a supercharger such as is used to allow an airplane to climb to record heights.

Through these test results there exists a basis for the interesting speculation of what the Diesel engine, when supercharged, may be able to accomplish toward allowing man to climb still higher toward the stars and to obtain great speed, miles up in the air. New possibilities that aerial combat of military planes may be carried to even dizzier heights open up also.

Diesel engineers say a supercharger on the Packard Diesel engine, by restoring the excess of oxygen the unsupercharged engine has at the ground or sea level, should restore or perhaps even increase the performance, starting at the unsupercharged engine's absolute ceiling and gaining speed and performance with increased altitude, just as with the unsupercharged Diesel engine, until the supercharged engine's absolute ceiling also is attained.

THE AMATEUR ASTRONOMER

(*Continued from page 417*)

said, "Give me a lever long enough and strong enough and I can lift the world." I would like to add, "Give me a pound of optical rouge and I can paint it red." Those were happy evenings of grinding, with the radio going and the recently acquired wife helping by furnishing popcorn and lemonade.

"After finishing the six-inch, I began the twelve-inch mirror shown in the picture. I

Mr. Calder and his collection

never had much more than an hour and a half at a time. Gordon Harder, who became interested in telescope making while I was working on my six-inch, volunteered to finish the job. The equatorial head, shown holding the six-inch reflector, deserves special mention. I was fortunate in being able to get Mr. Henry Harder, an expert machinist, to make this. The castings were made to order and I believe the job beats Ford axle, or pipe-fitting jobs. The polar axis turns on ball bearings, so that the motion is very smooth."

IN the April number mention was made of the aging of reducing solution. Later the following statement was made by Mr. Ferdinand Ellerman, astronomer on the staff of the Mount Wilson Observatory, who has charge of silvering the 100-inch mirror. "While the solution needs to age after mixing, in a similar manner to dry plates, the aging process improves both. But the dry plates reach a maximum sensitivity and after that begin to deteriorate. The silvering solution seems to reach a maximum and remain in that condition. As a rule we do not keep our reducing solutions more than two years, but we have a test bottle which is five years old and appears to be in as good condition as it was two months after it was made."

So that seems to be that. From the final clause of Mr. Ellerman's letter it may perhaps be deduced, incidentally, that he regards two months as about the right time to age the reducing solution before it is used.

No one has advised us yet concerning any accidents due to the explosion of spent silvering solution. It will be remembered that we commented on the recent Circular of the Bureau of Standards No. 389, "The Making of Mirrors by the Deposition of Metal on Glass," in which the risk involved in silvering without protective goggles was emphasized, and requested any amateur who knew of such an accident to advise us. It would seem that, with several thousand amateurs of all shades of experience working on the silvering of mirrors, a few at least ought to get their heads blown off if the risk is more than a minimum. It may be, however, that several hundreds have suffered this form of inconvenience without informing us, as a man without a head would tend to write fewer letters than one with head remaining in normal attachment. Once we interested one of our readers in amateur archeology and he ventured into the open places of Nebraska in search of ancient man. A blizzard came up and he froze to death. What share of responsibility for this sad accident we must shoulder is a question, but we should feel as bad if some amateur telescope maker were to be injured by an explosion of spent silvering solution, unless he had been warned in advance. On the other hand it ought not to be necessary to chase everybody out of the house and warn the neighbors before starting to silver a mirror, as we recall doing some years ago after taking the usual warnings very much to heart.

THE amateur telescope makers and users who constitute the Astronomical Section of the Academy of Science and Art of Pittsburgh have revealed to us that the First Annual Assembly of Amateur Astronomers and Telescope Makers of the Pittsburgh District will be held Saturday and Sunday, August 8 and 9. The program of activities includes a visit to the optical shops of J. W. Fecker, successor to John A. Brashear, where will be seen, among other interesting things, the 69-inch mirror cast at the Bureau of Standards for the Perkins Observatory of Ohio Weslyan University which is there being figured. Also an evening will be spent at the Allegheny Observatory where Director Jordan has granted permission to use the 13-inch refractor. By way of "trimmings" there will be a dinner in a park near the Observatory and a visit to Valley View Observatory, headquarters of the local organization just mentioned. (This homemade observatory is scheduled to be described in a special article in next month's number.)

Anyone interested in attending this new gathering of enthusiasts can obtain further information by addressing the Secretary of the Astronomical Section, Valley View Observatory, 106 Van Buren Street, Observatory Post Office, Pittsburgh, Pa. It will have much in common with the informal gatherings annually held at *Stellafane*, near Springfield, Vermont. Everybody comes that wants to, and all have a good time and a fine chance to swop experiences with other telescope makers and users. Better plan to drive to Pittsburgh for the August 8-9 week-end.

This announcement has no known bearing on the annual get-together held in Vermont. No announcement has been made with regard to the exact date of the latter. Why not take in both shows?

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> **MR LIDDY will be pleased to answer the inquiries of our readers who may desire information relative to the various subjects reported in his department**
> —*The Editor.*

"Finesse" Allowed as Soap Mark

IN the case of Marshall Field and Company *versus* Betts and Mumpeton Inc Trademark Interference No 1742 First Assistant Commissioner Kinnan held that Betts and Mumpeton Inc of New York New York is entitled to register the term Finesse as a trademark for toilet soaps although it did not commence the use of the mark on those specific goods until after its use on such goods by Marshall Field and Company of Chicago Illinois

The ground of the decision is that while Betts and Mumpeton Inc were the later of the two parties to adopt the mark on facial soaps it had used the mark long prior to that time on various other toilet articles including face powder and cleansing creams foundation creams lip sticks and so forth

In his decision after noting the facts as above and stating that Marshall Field and Company would be entitled to registration only if the goods upon which registration is sought were of different descriptive properties from those upon which Betts and Mumpeton Inc had previously used it the First Assistant Commissioner said

It is believed clear enough that toilet soaps belong in the same class and possess the same descriptive properties as these terms have been interpreted by the courts as the goods upon which the appellee first used the mark It is deemed obvious confusion in trade would result if this mark appeared in the same market upon the cosmetics to which the appellee first applied the mark and the toilet soap to which the appellant applies such mark

Dry Ice Suit Lost

THE United States Supreme Court on Monday March 9 1931 handed down its decision in the suit brought by the Dry Ice Corporation against the Carbice Corporation of America for infringement of Letters Patent No 1595426 for refrigerating apparatus using solid carbon dioxide as a refrigerant In the suit the defendant Carbice Corporation of America a manufacturer of solid carbon dioxide was charged with contributory infringement because it sold its product to customers of the Dry Ice Corporation with knowledge that the refrigerant was to be used by the purchaser in transportation packages like those described in the patent The Carbice Corporation challenged the validity of the patent and denied infringement The Supreme Court held that it need not determine whether the transportation package described in the patent was a patentable invention, for even if it was a patentable invention no relief could be granted plaintiff The court held in part as follows

The invention claimed is for a particular kind of package employing solid carbon dioxide in a new combination If the patent is valid the owner can, of course, prohibit entirely the manufacture sale or use of such packages (Continental Paper Bag Co *versus* Eastern Paper Bag Co 210 U S 405) Or it can grant licenses upon terms consistent with the limited scope of the patent monopoly (United States *versus* General Electric Co 272 U S 476 489) It may charge a royalty or license fee But it may not exact as the condition of a license that unpatented materials used in connection with the invention shall be purchased only from the licensor and if it does so relief against one who supplies such unpatented materials will be denied *The limited monopoly to make use and vend an article may not be expanded by limitations as to materials and supplies necessary to the operation of it*

Belgian Rayon Merger Planned

MOVED by keen international competition and increasingly high customs barriers in certain foreign markets Belgian financial institutions are said to be contemplating concentration of the rayon industry in that country as a preliminary to a large European rayon trust according to a report from Consul Walter H Sholes Brussels made public by the Department of Commerce

The Societe Generale de Belgique is reported to be particularly interested and it is estimated that the capital immediately involved is about 28 000 000 dollars No increase of capital would be contemplated inasmuch as the various firms appear to possess large reserves

Among the immediate objects of such a concentration of rayon interests would be a thorough rationalization of production methods and also of distributive functions The creation of a central export office is mentioned as a possibility in the latter instance The constitution of such a trust it is stated would be facilitated by the fact that the Belgian rayon groups have agreements with other international firms

Film Device Does Not Infringe

THE United States Circuit Court of Appeals for the Third Circuit has just ordered the dismissal of the patent infringement suit brought by the General Talking Pictures Corporation and DeForest Phonofilms Inc., against the Stanley Company of America for alleged infringement of patents on devices used in the reproduction of talking motion pictures

The machine which was held not to infringe the patents is made by the Western Electric Company, the opinion of Judge Buffington explains the company having assumed defense of the case.

Judge Buffington called attention in his opinion that the patents involved are not "the foundation stone so to speak, of the 'talkie movie art" since they involve only the utilization of the sound picture films after they are made and only in one respect the reproduction of sound

Concerning the method used in reproducing the sound films, the opinion states

In the already made photographic film which the patent in suit uses, the sound vibrations have been photographed on the sensitized film and without entering into details, it suffices to say the photographed modulations are evidenced by differences in film translucence Such being the case it follows that as such film is moved past an effective line of light these variations in translucency vary the quantity of penetrating light and so vary the degree to which the light cell is illuminated This results in corresponding electrical vibrations which in due course are translated by a loud speaker into sounds which correspond to and are in reality replica or re-creations of the sounds which had made the original sound record"

The principal patent sued on No 1607480 to Reis relates according to the opinion to the narrow sharply defined line of light penetrating the film and to the means of obtaining and using it" The Western Electric machine was found by the court to embody a different kind of slit differently located than the Reis patent, and therefore not to constitute an infringement

The other patents No 1698071 No 1466701 and No 1695414 to DeForest pertain to minor details of attachments of the apparatus and likewise were held not to be infringed The structure of two of these patents it was stated was never used in the art

Case Review Refused

THE Supreme Court of the United States recently declined to review the case of Pacent Reproducer Corporation v Western Electric Co, No 390 in which was submitted a question of a patentee's rights to grant licenses of a patent monopoly for different uses or fields of business for the invention The review was sought by way of petition for a writ of certiorari to the Circuit Court of Appeals for the Second Circuit, which the court denied.

The suit was one for patent infringement and it was declared in the petition to be of wide and general interest to the public because of the recent efforts of "American Telephone and Telegraph Company, General Electric, Westinghouse, Radio Corporation, and others to subdivide the monopoly granted by a patent"

The suit, according to the opinion of the lower court (V U S. Pat Q 105) was [illegible] tric Research Products [illegible] Telephone and Teleg[illegible] the present petitioners with infringement of the patents. The patents were owned by the American Telephone and Telegraph Company, the two other concerns having been granted nonexclusive licenses. By subsequent agreement the patent owner conveyed what the [illegible] license in specified [illegible] was exclusive in [illegible] the licensor itself and its previous licensees [illegible].

The petitioners [illegible] all three companies to sue as parties plaintiff, one being the patent owner and the others being licensees. The Circuit Court of Appeals, however, overruled this contention, declaring that under the construction of the licenses the joint action of the parties was proper.

By so doing, the petitioner claimed, the lower court rendered a decision that by the grant of an exclusive license limited to particular fields of use the monopoly conferred by letters patent for inventions and the right to sue as co-plaintiff with the owner of the patent for infringements thereof may in effect be divided into parts according to particular fields of use, although this is alleged to be without warrant or statute or judicial decision.

Will End Delay in Patent Grants

AN end of the delay in granting patents and considering claims for patents was promised by Thomas E. Robertson, Commissioner of Patents, in a radio talk recently broadcast.

"Following the World War," he declared, "the Patent Office, by reason of the increase in the number of applications and the large number of resignations from its trained examining corps, fell grievously behind with its work. For years extraordinary efforts were made to obtain increased personnel and increased salaries to cope with the situation.

"The efforts to obtain relief, made much greater by reason of the rigid economy imposed upon the government after the War, resulted in various increases and finally in a large additional force made available last Summer. This new force is being rapidly trained and its efforts are apparent since the accumulated work has already been reduced by 22,000 applications, or nearly 25 percent. Inventors and manufacturers have reason to be very hopeful that within about a year there will be no prolonged delays in obtaining actions upon their applications."

Plant Patents Sought

ABOUT 30 to 35 applications for patents on new kinds of plants have been received by the Patent Office, and the Department of Agriculture has started the difficult task of studying them to determine if the plants described are actually new, according to a statement by James A. Brearly, chief clerk of the Office. The law providing for patents on plants became effective May 23, 1930.

Both the Patent Office and the Department of Agriculture are proceeding carefully under the new law, Mr. Brearly said, since the field is entirely new and practices and principles must be developed [illegible] ntal [illegible] ince [illegible] to be used are new, it is expected that early decisions on applications will in many cases be taken to court.

An instance of the difficulties encountered is in the hypothetical case of a flower having a new odor. It is very difficult [illegible] comparable with [illegible] new type available at the Patent Office to compare its odor with that of a later flower for which a patent might be sought.

The law providing for plant patents excludes tubers from its scope. Irish potatoes are tubers, but sweet potatoes are not, being considered a root crop. Whether this view of botanists would be acceptable to the courts is a point which probably will have to be decided by them.

Vacuum Tube Patent Decision

THE Circuit Court of Appeals for the Third Circuit, sitting in Philadelphia, recently affirmed a decree of the District Court of Delaware holding that the Radio Corporation of America, the Westinghouse Electric & Manufacturing Company, The American Telephone & Telegraph Company, and several of their subsidiaries had by their agreements with their licensees attained a "patent pooling" monopoly on the sale of vacuum tubes to dealers and radio set manufacturers in violation of the Clayton anti-trust act.

The original injunction ordered against the Radio Corporation by Judge Morris was sustained by the Circuit Court of Appeals to which the Radio Corporation of America had appealed. After a trial of the case, Judge Morris granted a permanent injunction, and the recent decision of the said Circuit Court of Appeals, written by Judge Buffington, senior member of the Court, sustains the District Court and terminates the litigation unless the United States Supreme Court consents to review the decision of the Circuit Court of Appeals on a writ of certiorari.

The DeForest Radio Company claimed it had been frozen out of the tube market by the patent pool intended by the Radio Corporation to give it a monopoly in the sale of tubes to its licensee radio receiver manufacturers and dealers. The Radio Corporation countered that in effect no monopoly had been created, as shown by the increased sales of the plaintiffs. In treating this question Judge Buffington in his decision said, "There is nothing in them (the facts brought out in final hearing) which would lead us to the conclusion that the objectionable contract has not resulted in a monopoly."

Printing Must Not be Called "Engraving"

MISREPRESENTATION of a printing process as "Engraving" will be discontinued by Walter Howton and Max Leonhart, doing business in Chicago as Frank W. Black & Co., and Griffitts Engraving Co.

Howton and Leonhart are ordered by the [illegible] of a firm [illegible] other [illegible] that they [illegible] and until they actually do an engraving business, and from using the word "Engraved" or "Engraving" to describe products which they offer for sale, when all of the words and other figures on such products have not been produced from metal plates into which the words and other figures have been cut.

[illegible] proceeding is dismissed by the Commission in so far as it relates to Frank W. Black, who owned the business in question prior to his sale of it to Howton and Leonhart in November 1927.

The Commission found that the respondent's so-called "Nu-Process Method" is not a method of engraving but of printing. It does not require engraving, incision or cuts upon metal plates. The raised letters resulting from the firm's method are produced by the application of a powdered chemical to type printing, while the ink is wet. Heat is then applied to the chemical causing it to melt and fuse, producing a raised letter effect simulating engraving so closely that even experts cannot easily detect the difference.

Marks Must be Compared in Entirety

IT was recently held by Assistant Commissioner Moore that the Westinghouse Electric and Manufacturing Company, of East Pittsburgh, Pennsylvania, is entitled to register the term "Adjust-O-Matic" as a trademark for electric sadirons, notwithstanding the prior adoption and use by the Williams Oil-O-Matic Heating Corporation, of Bloomington, Illinois, of the terms "Oil-O-Matic" and "Dist-O-Matic" as trademarks for oil burners and the term "Ice-O-Matic" as a trademark for refrigerators.

The grounds of the decision are that the marks are not confusingly similar and the goods not of the same descriptive properties.

With respect to the marks, the First Assistant Commissioner stated that opposer's contention amounted to the claim that it was entitled to prevent others registering any mark containing the suffix "O-Matic", and said:

"Such a contention, carried to its logical conclusion, would prevent the other party from associating with any of its automatic household utilities the word 'Aut-O-Matic.' Obviously such contention is too broad and untenable."

With respect to the goods, he said:

"As to the properties of the respective goods, it is observed that oil burners and refrigerators obviously have not the same descriptive properties as electrically heated sadirons. They are classified in different classes in this Office."

He further said:

"In conclusion, it may be noted that confusing similarity between marks may not be determined by comparing only parts thereof. When the respective marks of the parties are compared in their entirety, and considered in connection with the respective goods with which they are used, it is believed that the dissimilarities of the marks and the different descriptive properties of the goods are such as would not be likely to confuse the public mind as to the origin of the goods."

Books SELECTED BY THE EDITORS

RADIO HANDBOOK

By J. A. Moyer, Mem. Fed. Com. on Radio Education, and
J. F. Wostrel, Inst. in Radio Engr.

ALTHOUGH the authors of this 886 page volume have, in many cases, included fundamentals of radio principles, the book is one that will interest mainly radio engineers and advanced radio experimenters and students. To absorb the greatest value from this work presupposes a background of physics, electricity, and mathematics; this of course is true of any radio book that attempts to get to the bottom of things. The authors have gathered between one set of covers a vast array of data covering every conceivable phase of modern radio technique. Here will be found information on apparatus and accessories; circuits, both fundamental and applied; commercial and broadcast equipment; laboratory materials—the list is far too long for the space allotted to this review. Vacuum tubes are treated extensively, both in their radio rôles and in their other industrial uses. This naturally brings one to the consideration of talkies and so a chapter is devoted to them. Photo-electric cells come in for their share of attention, and the chapter on television, while short, is comprehensive. It deals in main with the work of Dr E. F. W. Alexanderson of the General Electric Company.

Well done line drawings and halftones illustrate the text. A number of tables are noted for reference; this reviewer foresees that this handbook will serve to settle quickly many a moot question in the future.—$5.20 postpaid. —*A. P. P.*

PREPARING FOR AVIATION

By V. C. Finch, Lieut. U. S. N. (ret.)

BRIDGING the gap between the many primary books and those written for engineers with an advanced knowledge of mathematics, this text is based greatly upon the questions asked by students during the author's many years of active flying and flight instruction, together with an extended knowledge of airplane and engine design. The arrangement of subjects gives unity and continuity, and the engine data is as comprehensive as any we have seen.—$4.20 postpaid.

STANDARD WIRING 1931

By H. C. Cushing, Jr.

COMPLETELY revised and checked to date from most authoritative sources with a number of new chapters and sections, this pocket book of 504 pages covers the entire subject conclusively, both inside and outside wiring, street and highway lighting, illumination, together with the installation and care of storage batteries. Tables and illustrations in abundance complete the most useful book we have seen along this line.—$3.15 postpaid.

PRELIMINARY MATHEMATICS

By Prof. F. E. Austin

INTENDED for self help as a connecting link between arithmetic and algebra, and as an auxilliary with other textbooks, this little volume of 170 pages covers many points passed over in ordinary texts. It shows by numerous examples the practical application of each theory discussed. A splendid reference, too, for those who wish to brush up on some long disused method of calculation as we all find a need once in a while.—$1 40 postpaid.

THE REALM OF THE AIR

By Charles F. Talman

AS Librarian of the U. S. Weather Bureau the author has been custodian of a nearly exhaustive collection of literature which he has frequently drawn upon for articles in a popular vein that have appeared frequently to a wide circle. Added to this is a most happy style of writing in an entertaining and informative manner which transmits to the layman an understanding of this intricate and tricky subject. Weather is the most common topic of conversation and here you will find a lot to set you thinking. It will give you something with which to supplant the usual banal remarks.—$4.20 postpaid.

ACOUSTICS

By G. W. Stewart, Prof. Physics Univ. Ia., and
R. B. Lindsay, Prof. Theoretical Phys., Brown Univ.

A NEW textbook on the theory of acoustics, with such practical applications as acoustic measurements, architectural, physiological, and atmospheric acoustics, also subaqueous sound ranging and others. The authors rightly say that "the theory of acoustics has great beauty," but if, as happens even in the best regulated families, one's calculus has become a trifle dim this beauty may prove elusive. It is not at all an elementary book.—$5.[illegible] postpaid. —*A. G. I.*

THE STARS IN THEIR COURSES

By Sir James Jeans

WHOEVER wishes to get a good authentic picture of the science of astronomy as it stands today without going into all of its agonizing details or making a business of it may depend upon this book to give him such a conspectus in an evening or two. Jeans, the famous astronomer-cosmologist, usually writes profoundly and has an immense following, mostly among intellectuals. Here, however, he does not essay to fly high but comfortably—how comfortably may be judged from the fact that the book is a series of radio talks he recently gave in England and is therefore suited to a wide audience of average human beings.—$2.65 post paid.—*A. G. I.*

BUSINESS ADRIFT

By W. B. Donham, Dean, Grad. Sch., Business Admin., Harvard

WITHOUT resorting to alarmist tactics the author frankly presents all the facts which threaten the economic well-being of America and the world. The challenge of Russia, the fallacy of excessive dependence upon foreign trade, the need for foresight and an intelligent plan to meet changing business conditions are among the outstanding features of the author's discussion. A business man of wide experience looks squarely at our disorganized business structure and analyzes the problems we must meet and solve during the coming generation.—$[illegible].65 postpaid.

AUTOBIOGRAPHY OF AN ENGINEER

By William LeRoy Emmet

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VANCOUVER—A LIFE: 1757—1798

By George Godwin

THIS is a rare work of biography in that it is not padded. There are 177 pages detailing the life of the famous sailor and discoverer, for whom the city of Vancouver was named, while 131 pages are devoted to more or less technical and documented appendices. This gives the reader the picture painted in a large way, yet the added details are available if desired. George Vancouver entered the British navy at the age of 13 years. After making voyages of discovery with James Cook he commanded an expedition to take over from the Spaniards some territory they had seized on the northwest coast of America. He will be largely remembered as a scientific geographer surveying and charting hundreds of miles of coast, bays, and inlets and circumnavigating Vancouver Island. Other voyages included the Hawaiian Islands, Galapagos Islands, and much virgin territory. He seems to have been more or less of a martinet.—$4.20 postpaid.—*A. A. H.*

FIRST AID FOR BOYS

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FOR Boy Scouts and others interested in prompt help for the injured this book will be found to contain more explicit and detailed instructions over a wider range than any one we have seen. Clear and simple in its directions, with accompanying drawings to elucidate the text, older people may well keep it handy for it covers almost every conceivable emergency.—$1.65 postpaid.

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By William B. Seabrook

WITHOUT circumlocution the author states what he found and learned of black magic and tribal customs of life and living among the Gold Coast interior Africans. It is amazing in its intimate details and frankness and to the average reader will give an entirely different conception of these little known peoples. A book that will be widely read and avidly discussed, for it records a seemingly impossible range of observation.—$3.65 postpaid.

THE PSYCHOLOGY OF THE INVENTOR

By Joseph Rossman, Ph.D.

ALTHOUGH the inventor is responsible for the entire progress of humanity it is strange that no psychological study has been made as to the motives that impel him to invent; his mental processes, the methods which he follows, and the obstacles and difficulties which he encounters. The author, as an Examiner in the Patent Office, has come in contact with many inventors, thereby furnishing him with a sound background for his subject.

Valuable information has been obtained first hand from some of the most active and prominent inventors of this country, men who have secured hundreds of patents. Conclusions derived from this representative group should be of great importance to the reader interested in the art of inventing.—$3.20 postpaid.—*J. P. D.*

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By H. R. Smart, Asst. Prof. Philosophy, Cornell

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By C. Spearman, Prof. Psychology, London Univ.

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By Hereward Carrington

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6 North Michigan Ave., Chicago, Ill.

BLANCHARD-NICHOLS-COLEMAN
Western Advertising Representative: Los Angeles, San Francisco, Seattle, and Atlanta

SCIENTIFIC AMERICAN PUBLISHING COMPANY
Formerly Munn & Co., Inc., 24-26 West 40th Street, New York

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